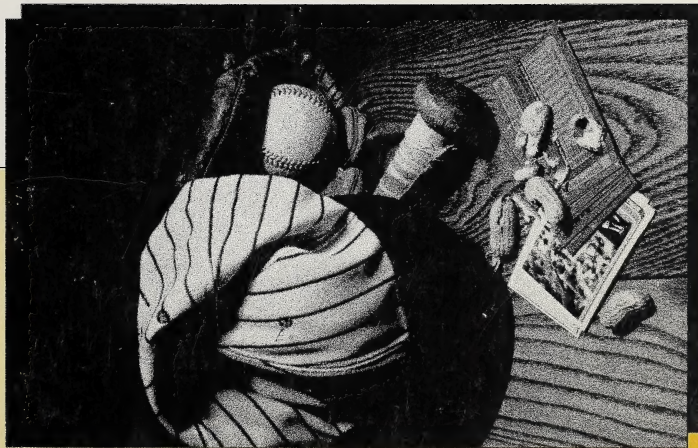
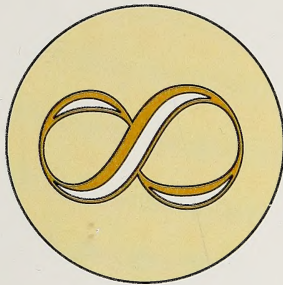




MATHEMATICS

CANADIANA


DEC 21 1992



MODULE 7 DATA MANAGEMENT



Alberta
EDUCATION



Digitized by the Internet Archive
in 2016 with funding from
University of Alberta Libraries

https://archive.org/details/mathematics807albe_1

Mathematics 8

Module 7: Data Management

MODULE BOOKLET

Mathematics 8
Student Module
Module 7
Data Management

ISBN No. 0-7741-0278-0

Instructional Design and Development: Alberta Distance Learning Centre
Typography, Lithography and Printing: Jasper Printing Group Ltd.

ALL RIGHTS RESERVED

Copyright © 1992, the Crown in Right of Alberta, as represented by the Minister of Education, Alberta Education 11160 Jasper Avenue, Edmonton, Alberta, T5K 0L2.

All rights reserved. Additional copies may be obtained from the Learning Resources Distributing Centre.

No part of this courseware may be reproduced in any form, including photocopying (unless otherwise indicated), without the written permission of Alberta Education.

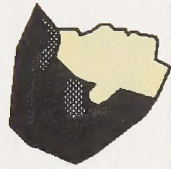
Every effort has been made both to provide proper acknowledgement of the original source and to comply with copyright law. If cases are identified where this has not been done, please notify Alberta Education so appropriate corrective action can be taken.

Welcome to Module 7!

*We hope you'll enjoy your study of **Data Management**.*

To make your learning a bit easier, a teacher will help guide you through the materials.

So whenever you see this icon,



turn on your audiocassette and listen.



THE UNIVERSITY OF CHICAGO
LIBRARY
1215 EAST 58TH STREET
CHICAGO, ILL. 60637
U.S.A.

Module Introduction	1
Section 1: Getting Set	5
Section 2: Pictographs	21
Section 3: Bar Graphs	31
Section 4: Line Graphs	43
Section 5: Circle Graphs	57
Section 6: Misleading Graphs	73
Section 7: Data Collection	81
Section 8: Summary	97
Module Conclusion	99
Appendix	101



What Lies Ahead

In this module introduction you will learn the importance of learning about statistics. You will also preview the components of the module and discover how the module is evaluated.



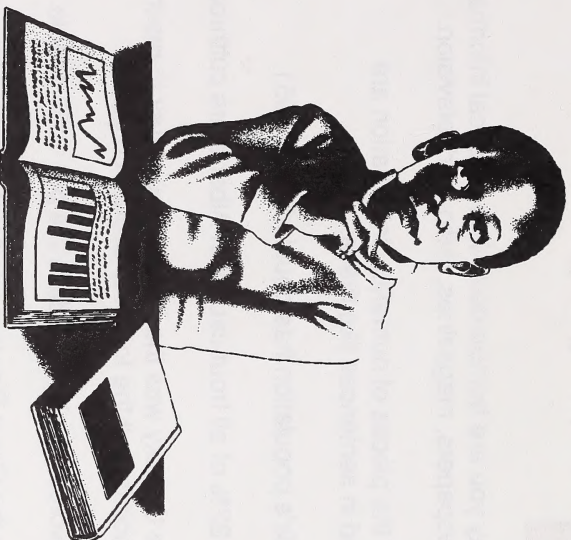
Working Together

Every day you are bombarded with numerical information from newspapers, magazines, radio, and television.

Some of the pieces of numerical information are presented in sentences like these:

- Canada's population has doubled since 1951.
- About 22% of all trout caught in Alberta are cutthroat.
- Wayne Gretzky was the first hockey player to reach 2000 points and the fourth to score 700 goals.
- The divorce rate in Canada is 2.4 per 1000 people.
- During the Great Depression, 1 out of 4 people was out of work.

Sometimes the pieces of numerical information are displayed in charts and graphs.



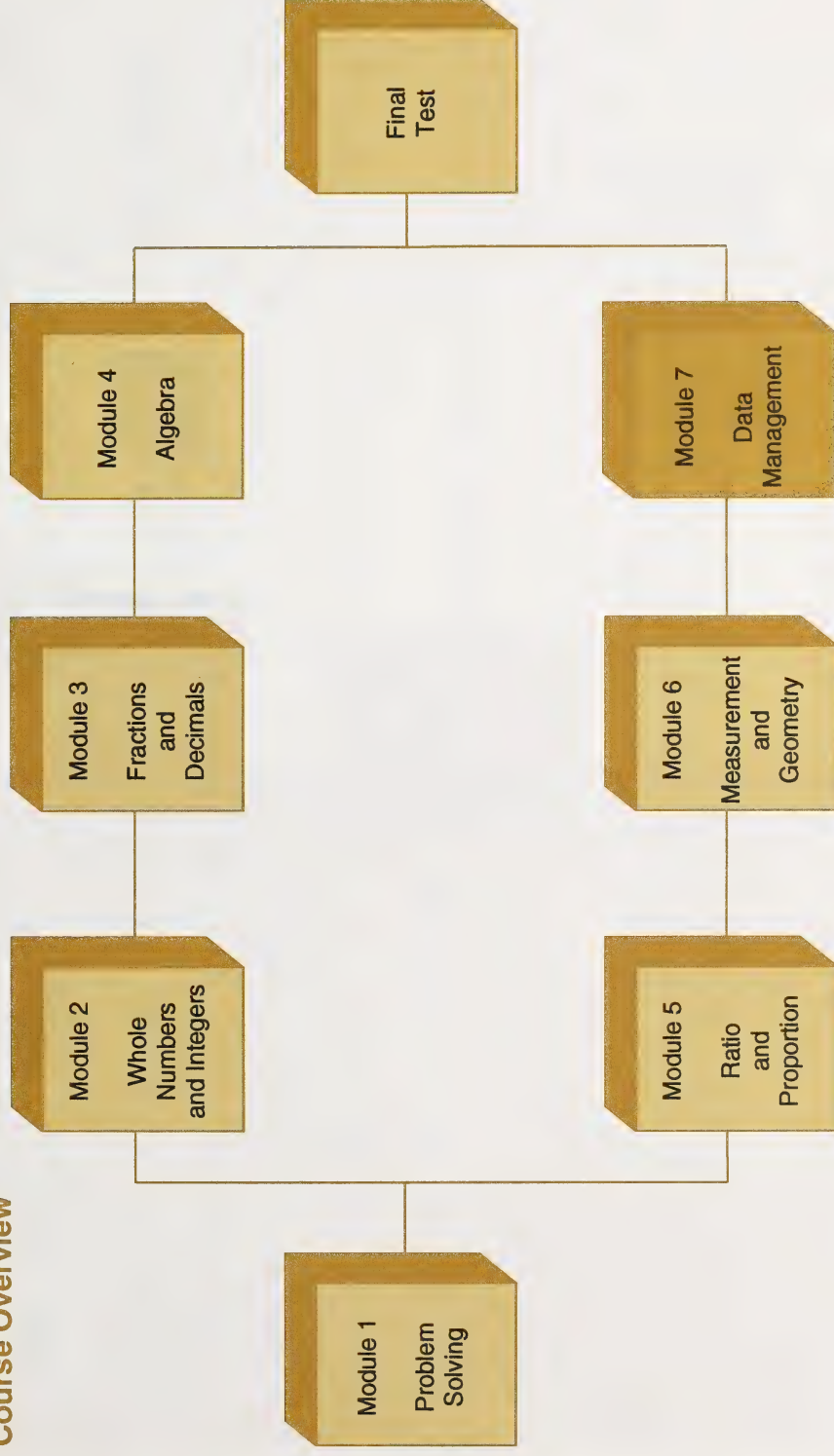
These pieces of numerical information are called **data**. The word *data* is plural (we say “data are...”), but hardly anyone uses the singular form *datum*, which refers to only one number or piece of information.

Statistics is the science of collecting, organizing, and drawing conclusions from data.

For many people the first word that comes to mind when they think of statistics is “lies.” Statistics, like other means of communication, can be used to mislead people. However, most researchers try very hard to be as accurate as possible.

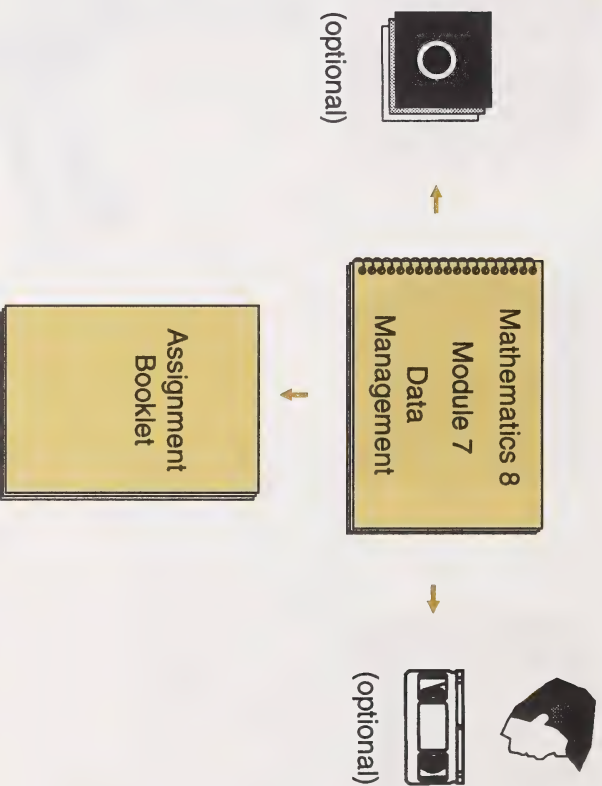
In this module you will learn how to manage data properly and how to recognize the misuse of statistics.

Course Overview



Mathematics 8 has seven modules and a final supervised test. This module booklet is part of Module 7.

Module 7 Components



This module booklet will give you instruction and practice in learning mathematical skills and words. It will also direct you to the other components of the module. The computer and video activities in this booklet are optional; there are print alternatives. You should see your learning facilitator to check your answers to the activities in this booklet. This booklet is not to be submitted for a grade.

Your mark on this module will be determined by your work in the assignment booklet.

Take time to preview this module booklet before beginning Section 1.



What Lies Ahead

This section will test these skills.

- keeping tallies and making frequency tables
- constructing and interpreting pictographs, bar graphs, line graphs, and circle graphs
- recognizing misleading graphs
- distinguishing between a population and a sample
- recognizing a biased sample



Working Together

This section tests skills with data management that will be taught in this module.

Pretest

Space for Your Work

1. The students in Grade 7C were asked how many teeth fillings they had during their lifetimes.

They responded as follows:

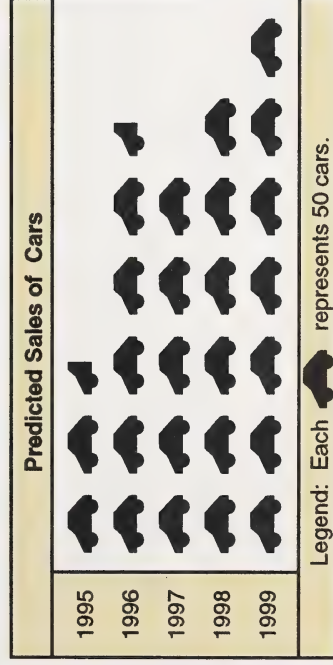
3, 4, 5, 8, 2, 0, 6, 7, 4, 4,
8, 6, 1, 1, 4, 6, 3, 5, 7, 4,
1, 2, 3, 0, 0, 2, 5, 6, 2, 1,
0, 4, 3



Complete the following chart and find the frequency for each number of fillings.

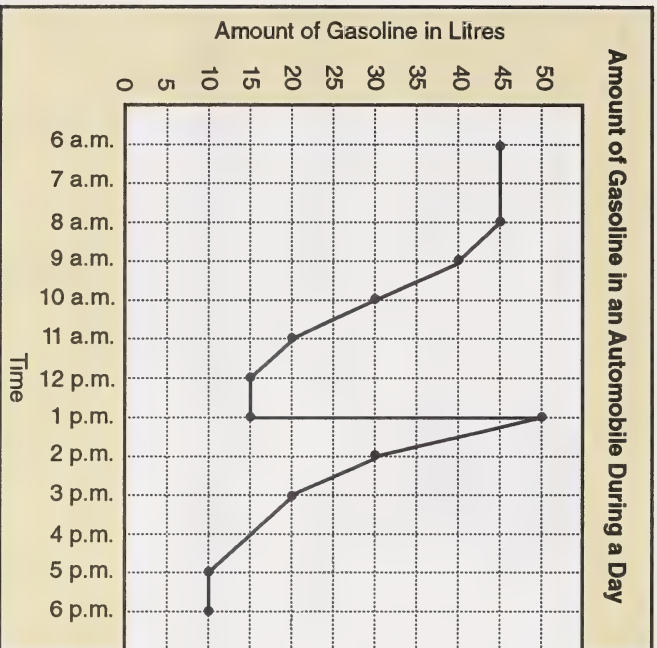
Number of Fillings	Tally	Frequency
0		4
1		
2		
3		
4		
5		
6		
7		
8		

2. Super Charge Vehicles Ltd. are predicting their sales of electric cars. The first automobile will be a 4-seater Hummalong. With its large battery, it is expected to go 250 km before the battery needs to be recharged. Recharging should only take $1\frac{1}{2}$ hours. The predicted sales are displayed in this graph. Study this graph. Then answer the following questions.



3. Study the graph below. Then answer the questions on the next page.

Space for Your Work

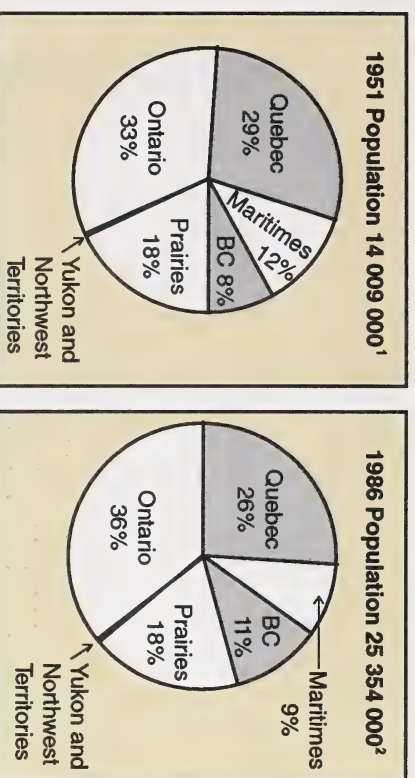


Space for Your Work

- a. When did the driver of the car leave home?
- b. When did the driver eat lunch?
- c. When did the driver arrive home?
- d. What do you think the driver does for a living?
Why?
- e. When did the driver fill up the gas tank?
- f. How much gas did the driver purchase?
- g. What is the capacity of the tank?
- h. How much gas is left in the tank at 6 p.m.?

4. Study these graphs. Then answer the questions on the next page.

Space for Your Work



Note

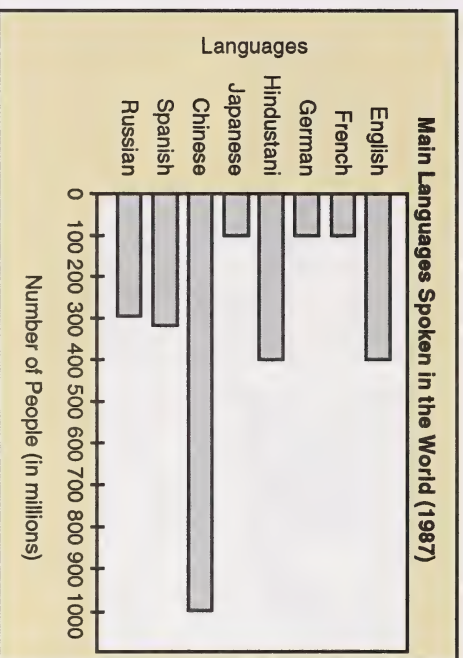
The Yukon and Northwest Territories are included as lines on these graphs because their combined population is less than 1% of the total population of Canada.

^{1,2} Statistics Canada.

- a. In what regions of the country did the percentage of population increase from 1951 to 1986?
- b. What was the total population of Canada in the following years?
 - (i) 1951
 - (ii) 1986
- c. Calculate the population of the Prairies in the following years.
 - (i) 1951
 - (ii) 1986

5. Study this graph. Then answer the following questions.

Space for Your Work

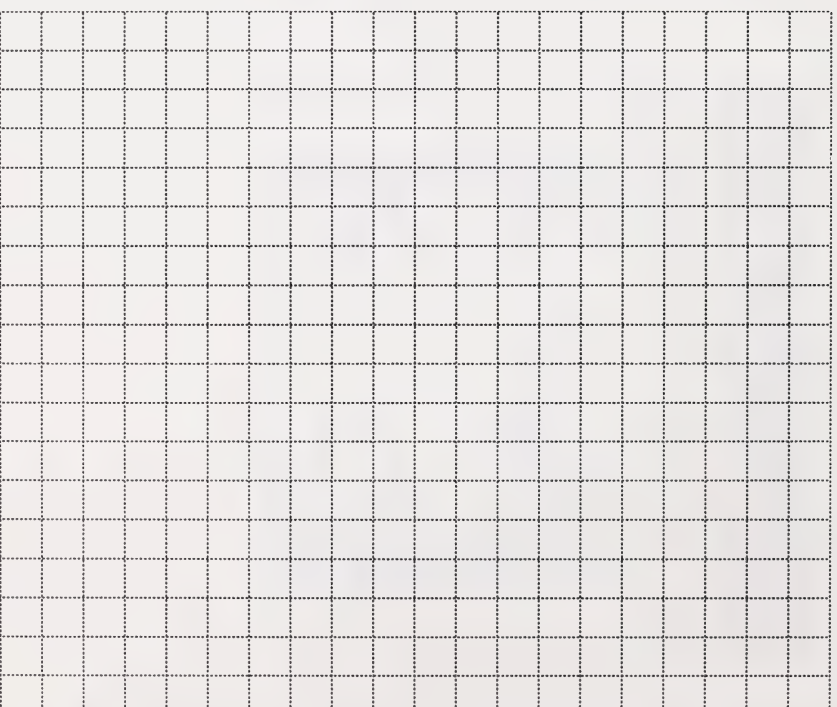


- Which language is spoken by the greatest number of people?
- About how many people speak English?
- About how many people speak French?

7. Make a bar graph to represent this data.¹

Space for Your Work

The Longest Rivers in Canada	
River	Length
Mackenzie	4 241 km
Yukon	3 185 km
St. Lawrence	3 058 km
Nelson	2 575 km
Columbia	2 000 km
Saskatchewan	1 939 km
Peace	1 923 km
Churchill	1 609 km
South Saskatchewan	1 392 km
Fraser	1 370 km
North Saskatchewan	1 287 km
Ottawa	1 271 km



¹ Statistics Canada.

8. Teresa's parents kept a baby book and recorded her height at birth and on every birthday.

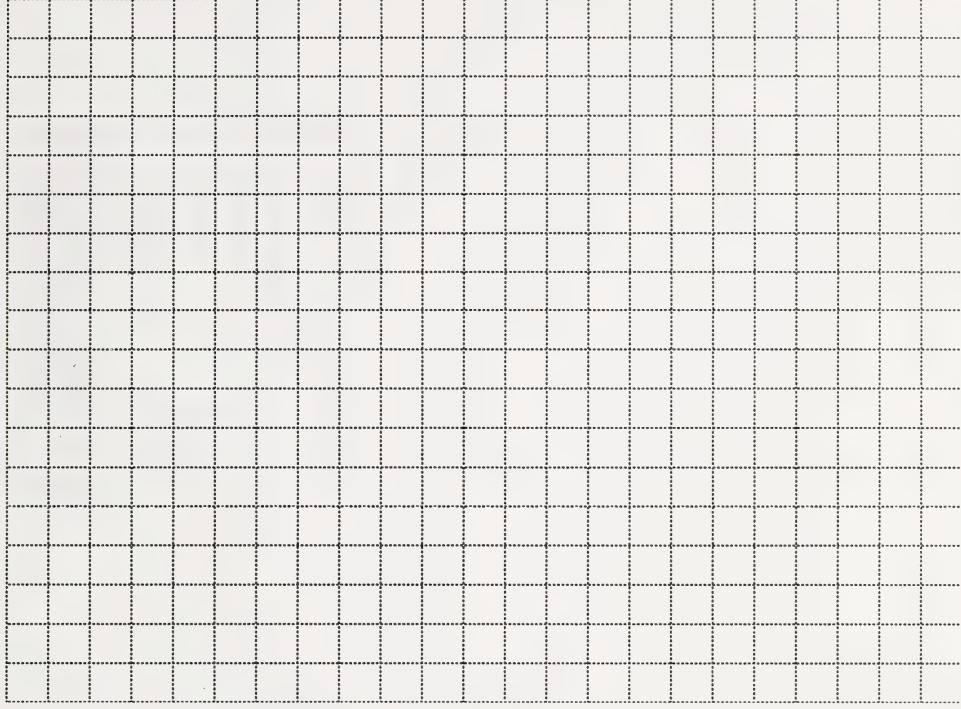
Theresa's Growth	
Age (a)	Height (cm)
birth	51
1	76
2	86
3	94
4	101
5	104
6	115
7	119
8	130
9	135
10	141

Make a line graph to display this data.

Note

The metric symbol for years is a.

Space for Your Work

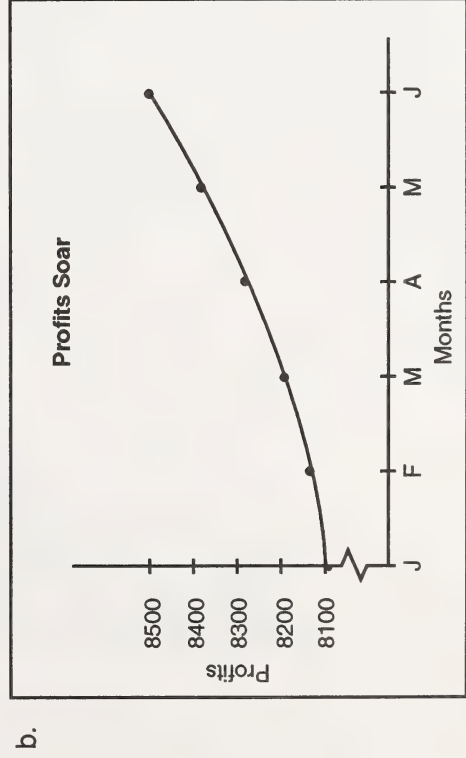
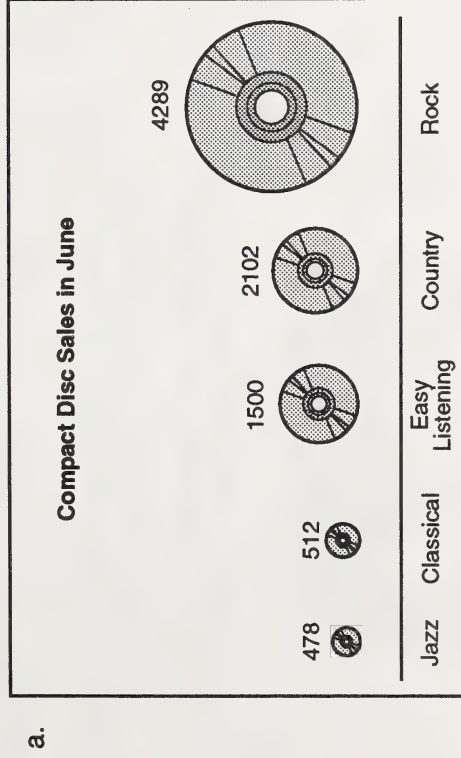


9. Make a circle graph to display this data.

Space for Your Work

Money Raised by Student Council	
Student Cards	\$12 000
Canteen	\$6 000
Dances	\$2 000
Athletics	\$10 000
Fund raiser	\$10 000
Total	\$40 000

10. Explain why each of the following graphs is misleading.



11. Define the following terms used in statistics.

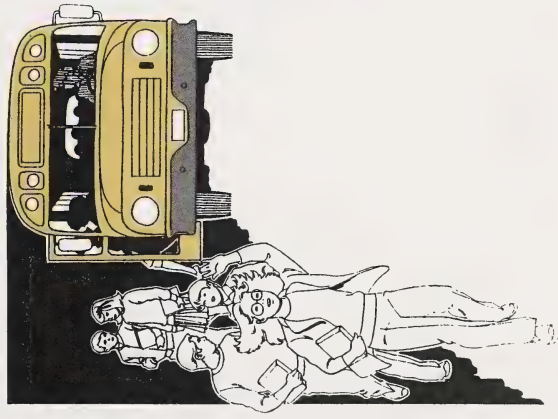
- a. population
- b. census
- c. sample
- d. biased sample
- e. random sample

12. a. Yvonne wants to discover how many people in her town can swim. Explain how she could conduct a census to determine this.

- b. Explain how Yvonne could use sampling to estimate the number of people who can swim in her town.



13. Max wants to discover how far from school the students at his school live. Which sampling technique would produce more accurate results? Why?
- Max asks every third student who gets off the school bus, "How far from school do you live?"
 - Max asks every fifth child entering the school, "How far from school do you live?"



14. There are 592 people who have library cards at Cumberland library. Rachel decides to mail a questionnaire to card holders to ask their opinion about purchasing more foreign language books. Which sampling technique would produce more accurate results? Why?

- Mail questionnaires to five card holders whose names are selected at random from a list.
- Mail questionnaires to 60 card holders whose names are selected at random from a list.



See your learning facilitator to check your answers and to receive further instructions.



What Lies Ahead

In this section you will learn these skills.

- interpreting pictographs
- constructing pictographs



Working Together

In this section you will learn about pictographs.

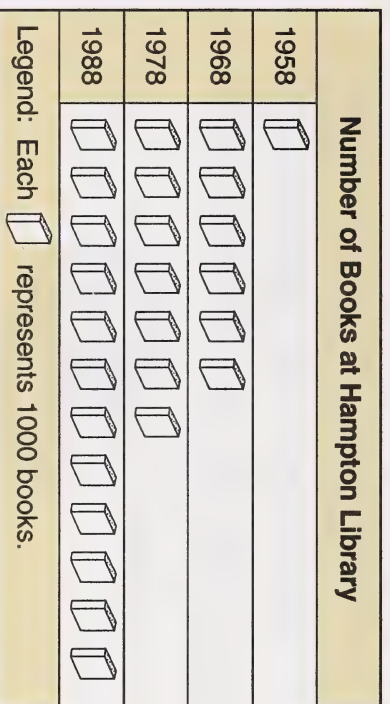
A **pictograph** is a graph that uses symbols to display numerical information. As its name implies, a pictograph is a little picture that has some relationship to the topic.

Each pictograph has a legend. The **legend** explains what the symbols mean.

Each pictograph also has a descriptive title.

Example

A town library was established in 1958. Since then it has improved its service and the number and quality of books. The following pictograph summarizes the growth of the library.



Compare the pictograph to the following frequency table.

Number of Books at Hampton Library	
Year	Number of Books
1958	1 012
1968	6 082
1978	7 015
1988	12 003






























































Notice that the pictograph is more effective in showing that the number of books is rising steadily!

However, you should remember that the information in a pictograph is **not** always accurate; it is often approximate.

Sometimes a whole symbol is used in a pictograph. At other times fractions of the symbol are used.






























































Example 1

The fish and wildlife authorities try to keep accurate records of how much fish is taken from commercial fishing lakes. Over the last five years, data has been kept on Big Whitefish Lake.

Fish Caught in Big Whitefish Lake	
1984	           
1985	           
1986	           
1987	           
1988	           
Legend: Each  represents 500 kg of fish.	

Note:  = 250 kg of fish


Example 2


Populations of Alberta Cities (1986) ¹	
Calgary	           
Edmonton	           
Lethbridge	           
Red Deer	           
Grande Prairie	           
Legend: Each  represents 100 000 people.	

Note:

 = 75 000

 = 50 000

 = 33 000

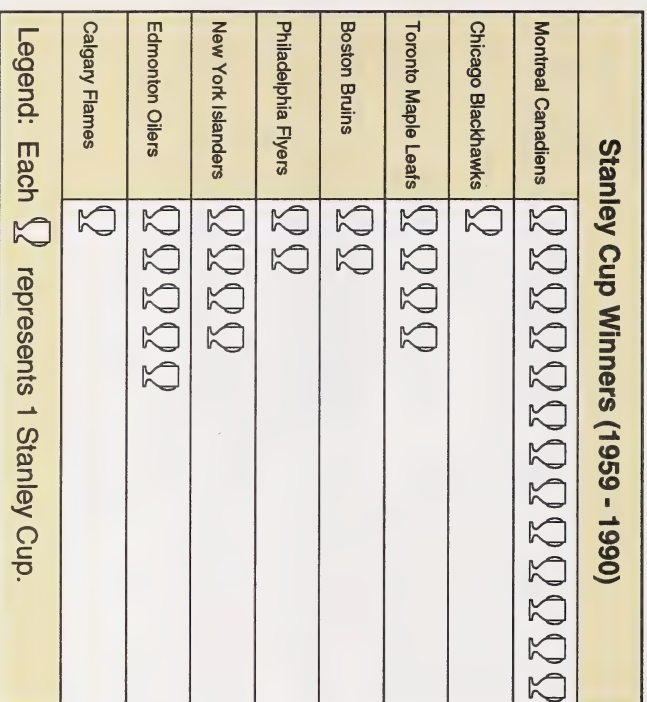
 = 25 000

¹ Statistics Canada.

Introductory Activities

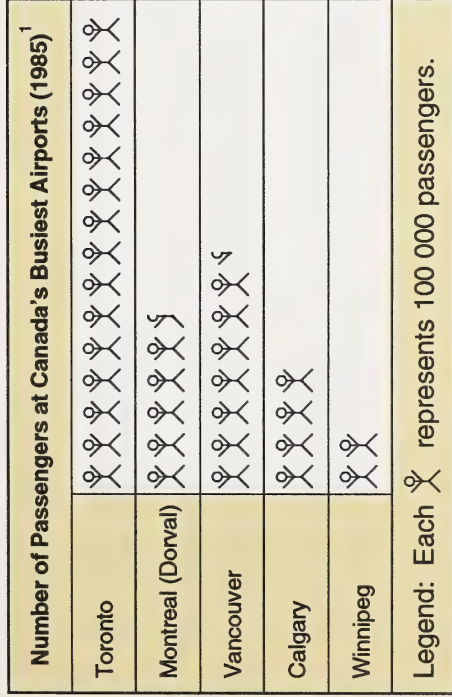
Space for Your Work

1. Use the pictograph to answer the following questions.



- a. Which hockey team won the most Stanley Cups from 1959 - 1990?
- b. How many Stanley Cups did the Edmonton Oilers win from 1959 - 1990?
- c. How many Stanley Cups did the Calgary Flames win from 1959 - 1990?

2. Use this pictograph to answer the following questions.

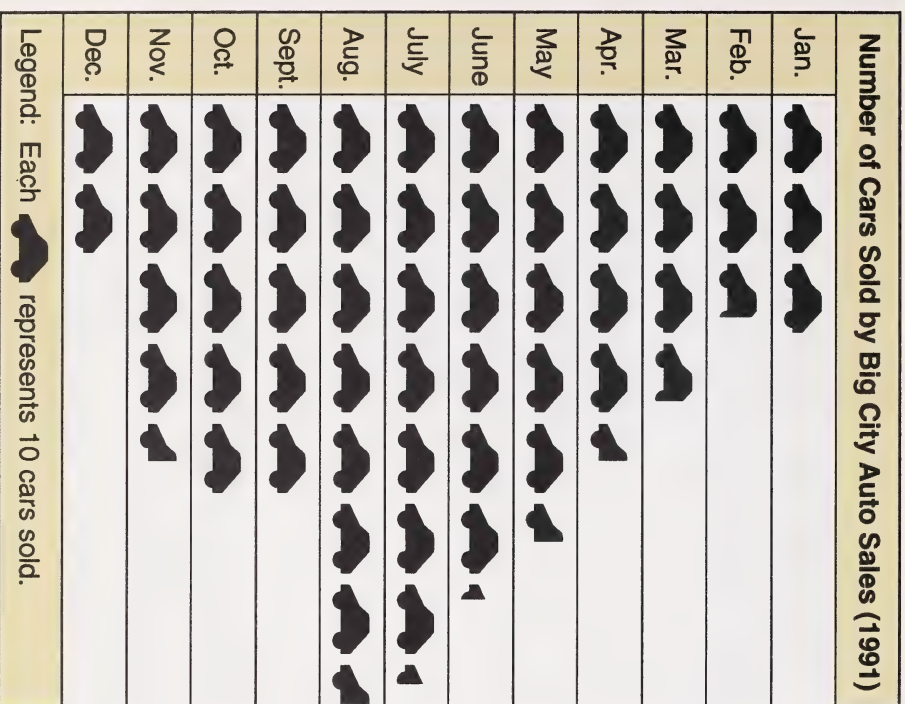


- Which airport was the busiest in Canada in 1985?
- Did the Vancouver airport handle more passengers than the Montreal (Dorval) airport in 1985?
- How many more passengers were handled in Vancouver than in Calgary in 1985?

¹ Statistics Canada.

3. Use the pictograph to answer the questions on the next page.

Space for Your Work



a. How many cars were sold in these months?

(i) August, 1991

(ii) December, 1991

b. How many more cars were sold in June, 1991 than in January, 1991?

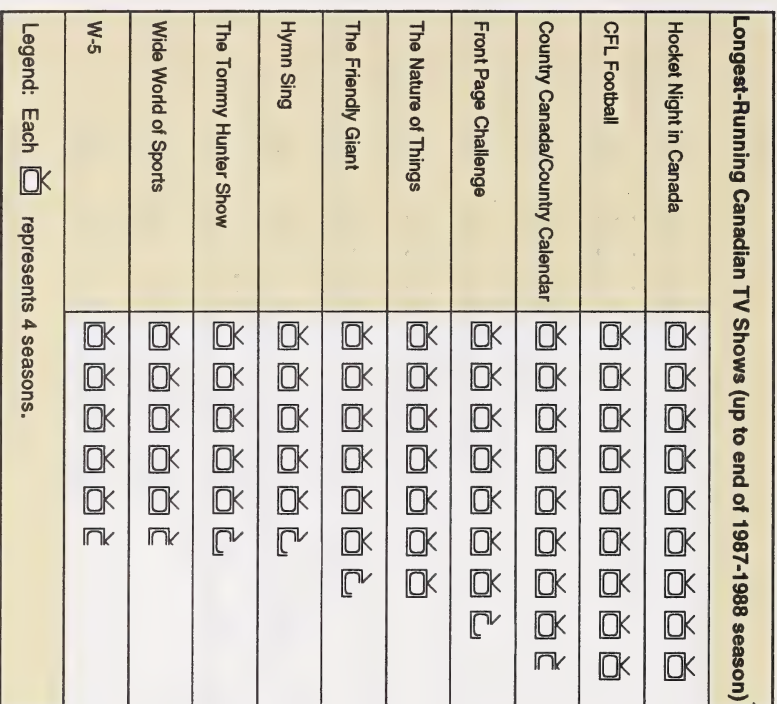
c. If each car was sold for \$12 000, how much money was brought into the business in April, 1991?

d. Does this pictograph tell you clearly which were the best and worst months in 1991 for car sales?

Space for Your Work

4. Use the pictograph to answer the questions on the next page.

Space for Your Work



¹ Statistics Canada.

How many seasons had the following shows run up to the end of 1987-1988 season?

- a. Hockey Night in Canada
- b. Front Page Challenge
- c. W-5

Space for Your Work

See your learning facilitator to check your answers and to receive further instructions.

Practice Activities

These were the top money-making films up to 1987.

Film	Total Rental
E.T. The Extra Terrestrial (1982)	\$227 960 804
Star Wars (1977)	\$193 500 000
Return of the Jedi (1983)	\$168 002 414
The Empire Strikes Back (1980)	\$141 600 000
Jaws (1975)	\$129 961 081

Construct a pictogram to display this data. Use  to represent \$30 000 000.

See your learning facilitator to check your answers and to receive further instructions.

Space for Your Work

[illegible]



What Lies Ahead

In this section you will learn these skills.

- interpreting a bar graph
- constructing a bar graph



Working Together

You have just finished a section on pictographs. You'll remember that a pictograph shows information by giving us a little picture of what the numbers are trying to reflect.

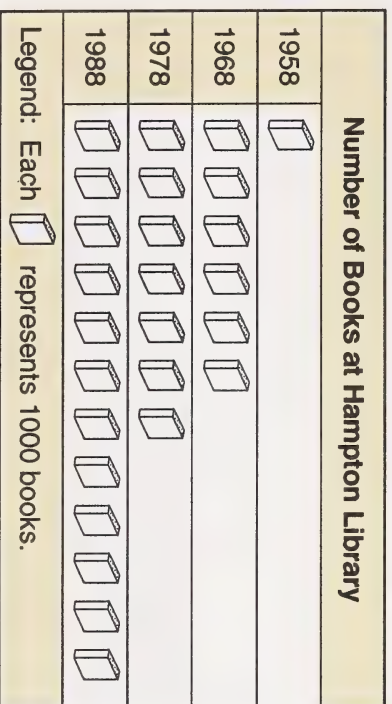
In this section you will learn about bar graphs.

Do you recall the example about the growth in the number of books in the Hampton Library?

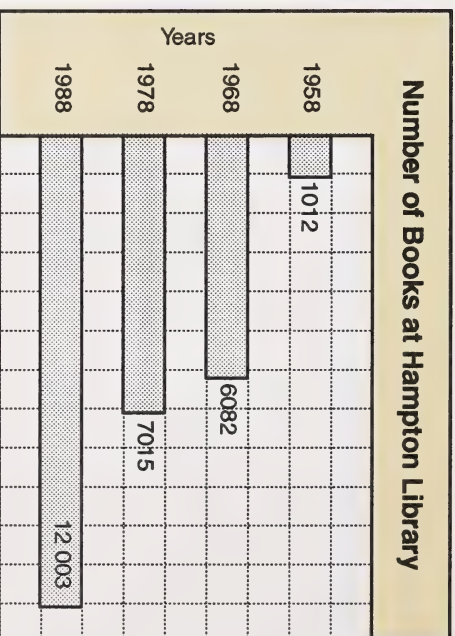
Number of Books at Hampton Library

Year	Number of Books
1958	1012
1968	6082
1978	7015
1988	12 003

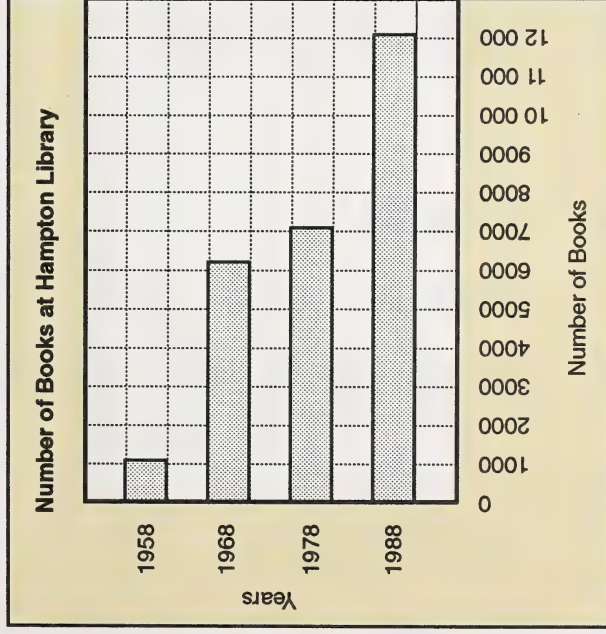
In the previous section, you displayed this information in a pictograph.



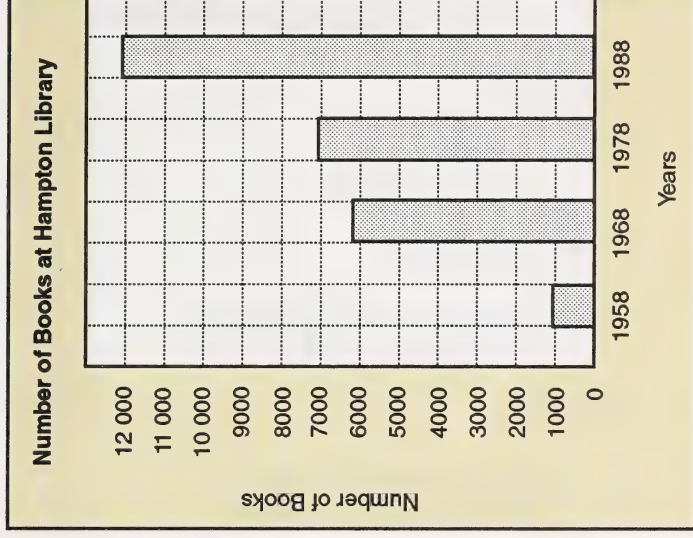
This information can also be displayed in a bar graph. In a bar graph, bars are used instead of pictures. Sometimes bar graphs can have the data recorded beside the bars.



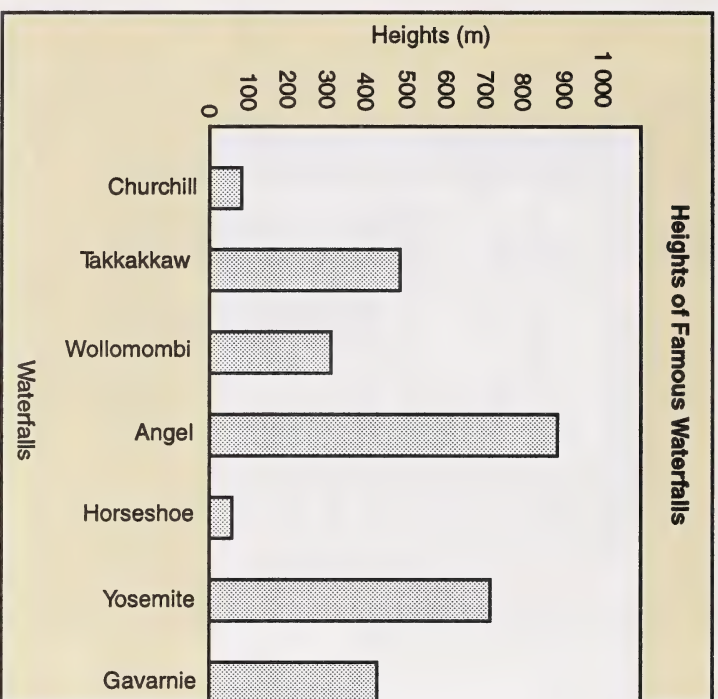
Often bar graphs have a scale. Here the scale is along the bottom of the graph. You can use the scale to “read” the graph and determine the approximate size of the bars. The guide lines help you.



Here the scale is labelled on the left side of the graph.



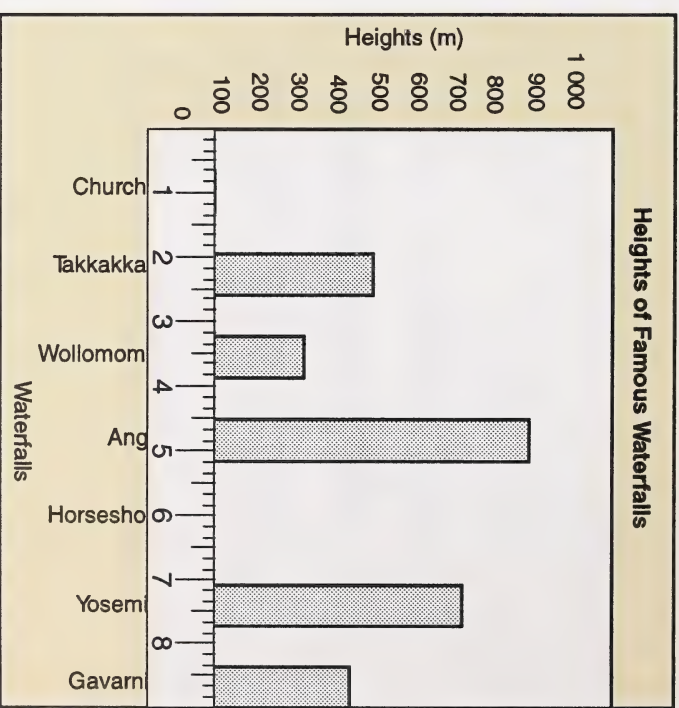
In the following bar graph the guide lines are not included.



You may need to use a straightedge to help you read the scale across from the bar.

Example

What is the height of Churchill Falls?

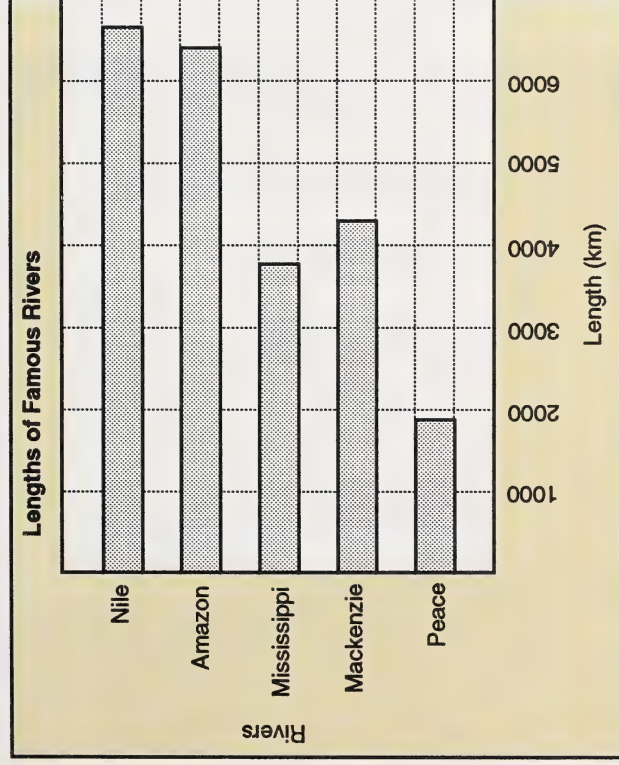


The height of Churchill Falls is about 80 m. You will have to estimate because the bar is between the 0-m mark and the 100-m mark on the vertical axis.

Introductory Activities

Space for Your Work

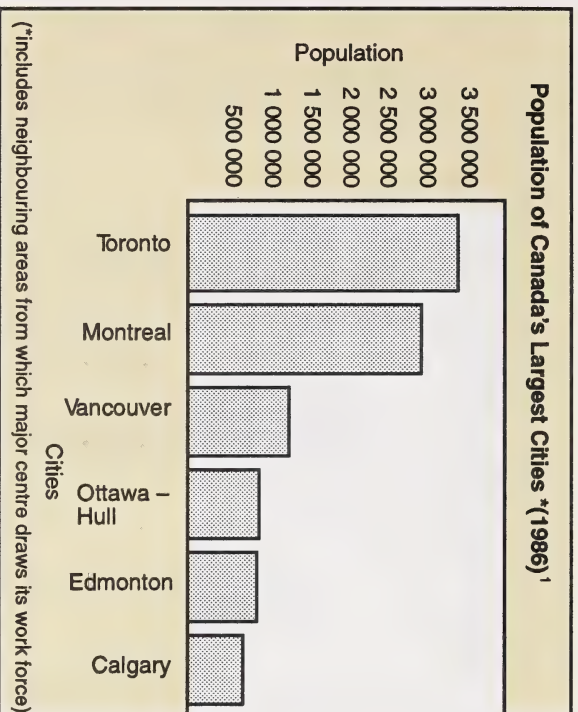
1. Use the bar graph to answer the following questions.



- a. How long is the Amazon River?
- b. How long is the Nile River?
- c. How long is the Peace River?

2. Use the graph to answer the following questions.

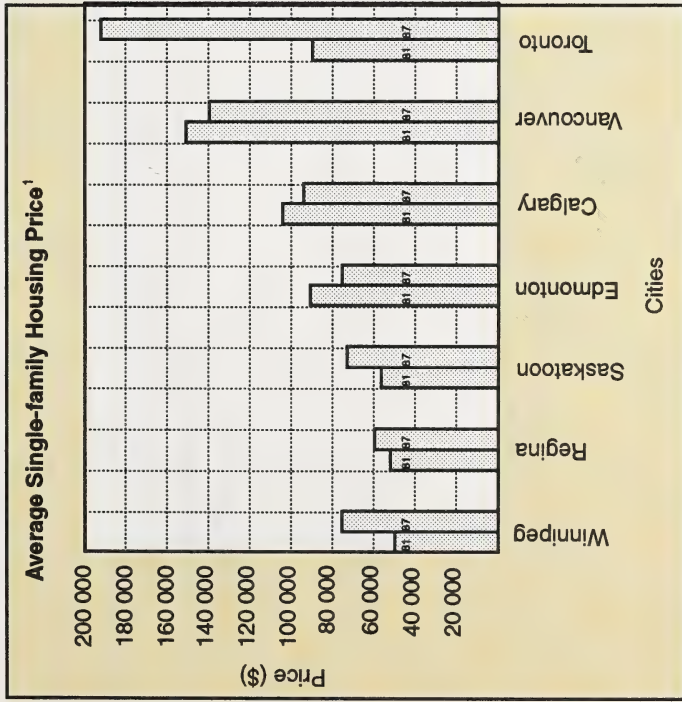
Space for Your Work



- How many people lived in Calgary in 1986?
- How many people lived in Montreal in 1986?
- How many people lived in Vancouver in 1986?

¹ Statistics Canada.

3. Use the graph to answer the following questions.

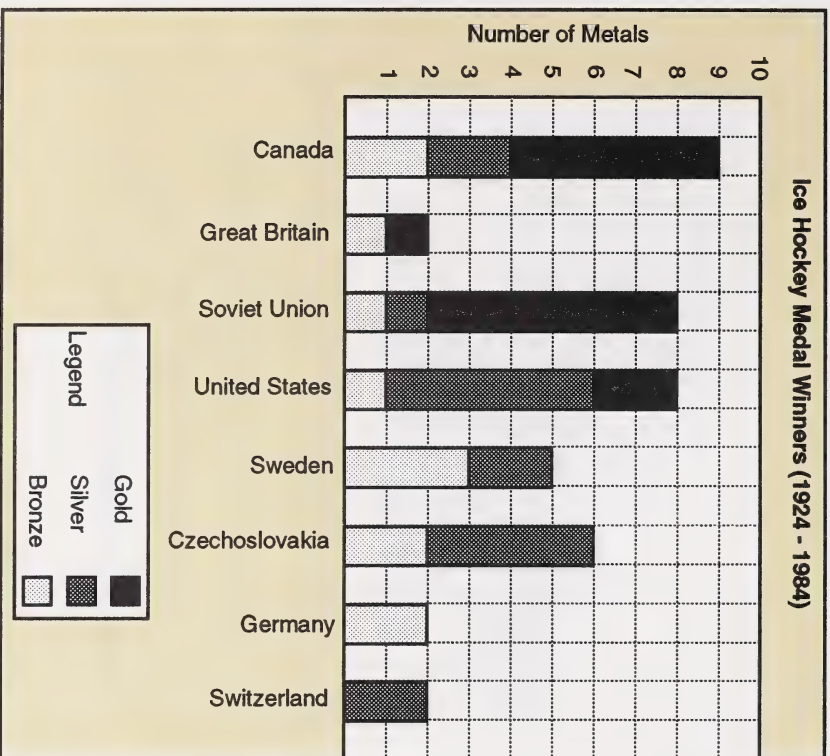


- In which city did houses cost the most in 1981?
In 1987?
- By how much did house prices increase in Vancouver between 1981 and 1987?

¹ Statistics Canada.

4. Use the graph to answer the questions on the next page.

Space for Your Work



- a. Which country won the most ice hockey medals from 1924 to 1984?
- b. The Soviet Union and United States won the same number of ice hockey medals from 1924 to 1984. Which of these countries won the most gold medals?
- c. Which countries have won gold medals in ice hockey during the period?
- d. How many gold medals in ice hockey did Canada win during the period?



See your learning facilitator to check your answers and to receive further instructions.



Working Together

Constructing a Bar Graph

Bar graphs should have these features

- a descriptive title
- a horizontal axis and a vertical axis which are named accurately or data displayed beside each bar
- good use of space (appropriate scale)
- bars equal in width and equally spaced

The most difficult part of making a bar graph is choosing an appropriate scale. To do this, consider the data you wish to display.

What is the highest number? What is the lowest number?

This will help you decide what each unit should be.

Be sure to make good use of space.

Example

Construct a bar graph using this data.

Average Single-Family Housing Price in 1987¹

City	Price (\$)
Winnipeg	78 286
Regina	65 078
Saskatoon	72 977
Edmonton	77 373
Calgary	93 102
Vancouver	132 658

Note

The highest price is \$132 658.

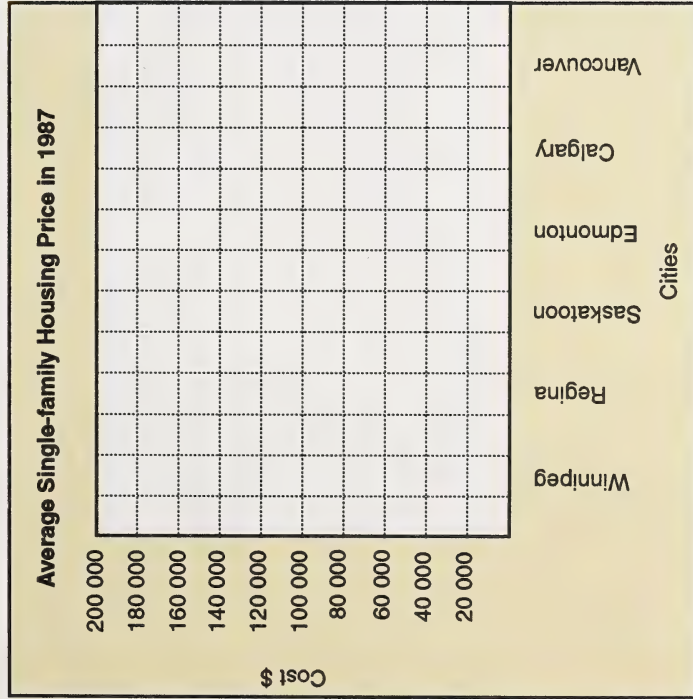
The lowest price is \$65 078.

You may wish to make each unit \$20 000.

¹ Statistics Canada.

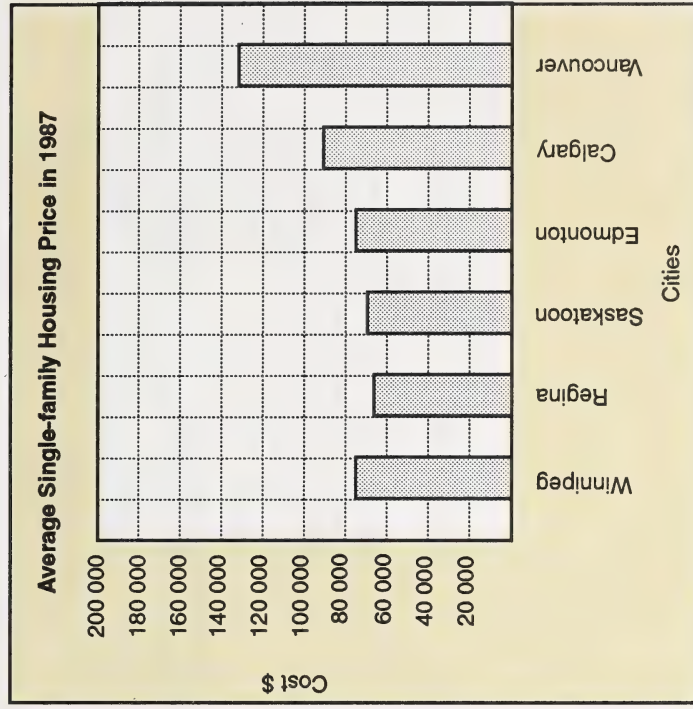
Step 1

Label the title and axes (including the scale).



Step 2

Make the bars. You will have to approximate the cost.



Practice Activities

Space for Your Work

Construct a bar graph to display the following data.

Population by Continents (1988)	
Asia	3 031 100 000
Europe	684 800 000
Africa	615 300 000
Australia	25 500 000
North America	413 100 000
South America	282 200 000



See your learning facilitator to check your answers and to receive further instructions.



What Lies Ahead

In this section you will learn these skills.

- interpreting a line graph
- drawing a line graph



Working Together

So far you have studied the pictograph and the bar graph — both are very useful and meaningful ways of presenting information. Probably the most common graph used is the line graph. The line graph shows how measurements change.

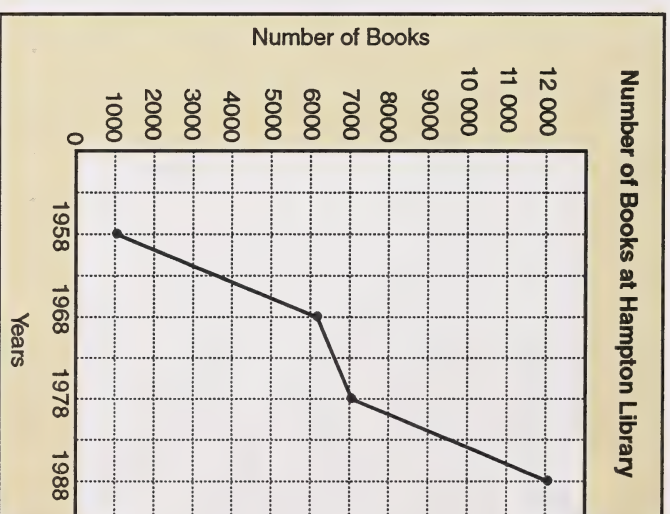
Example 1

Do you recall the example about the growth in the number of books in Hampton Library?

Earlier in this module the information was displayed in a pictograph, a vertical bar graph, and a horizontal bar graph.

This information can also be displayed in a line graph by plotting ordered pairs and joining the dots.

Number of Books at Hampton Library		
Year	Number of Books	Ordered Pairs
1958	1012	(1958, 1012)
1968	6082	(1968, 6082)
1978	7015	(1978, 7015)
1988	12 003	(1988, 12 003)



Note

Because of the scale, the second numbers in the ordered pairs are approximate. Example (1988, 12 003) is rounded to (1988, 12 000).

Example 2

Gurtek had a research project to determine at what time of the day it was hottest. He took temperature readings from 8 o'clock in the morning until 6 o'clock in the afternoon. He collected the following data.

Time	Temperature ($^{\circ}\text{C}$)
8 a.m.	11
9 a.m.	14
10 a.m.	12
11 a.m.	13
Noon	19
1 p.m.	20
2 p.m.	23
3 p.m.	25
4 p.m.	24
5 p.m.	21
6 p.m.	15

The data can be displayed on a line graph.

Note

Because of the scale, the dot is sometimes between the numbers on the vertical axis. Example (Noon, 19). The dot is between 15 and 20 but closer to 20 on the vertical scale.

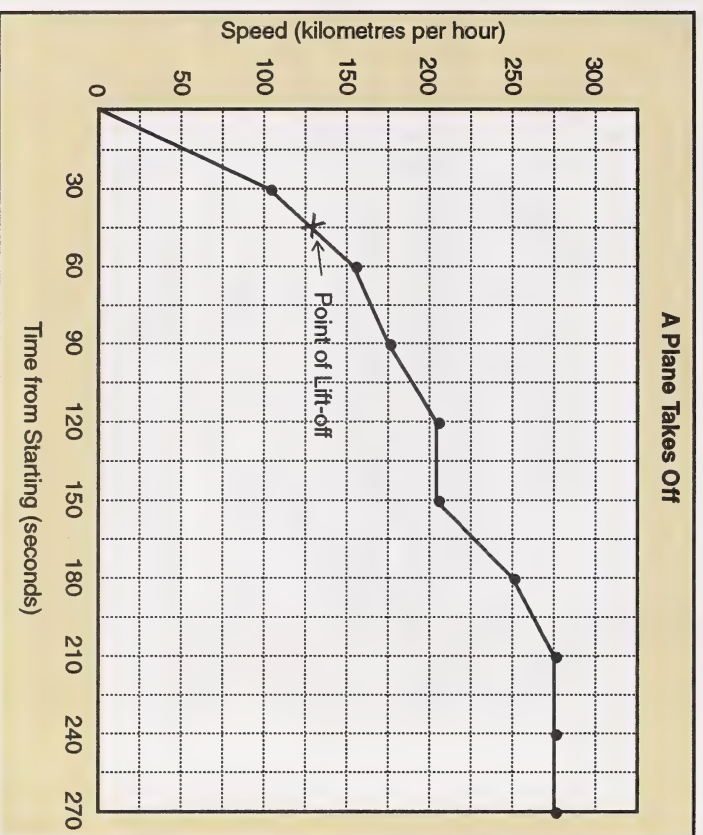
Temperatures at Barrhead, Alberta on June 15, 1989



Introductory Activities

Space for Your Work

1. Use the graph to answer the questions on the following page.

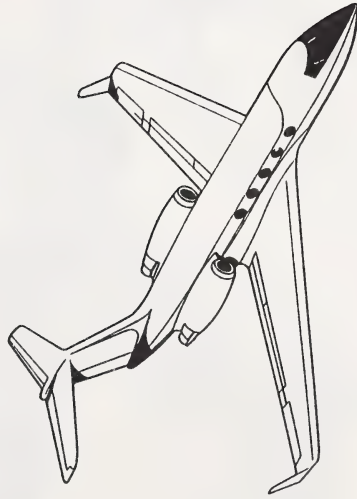


a. When did the plane lift off?

b. How fast was the plane travelling when it lifted off?

c. Did it change its speed between 2 minutes and $2\frac{1}{2}$ minutes?

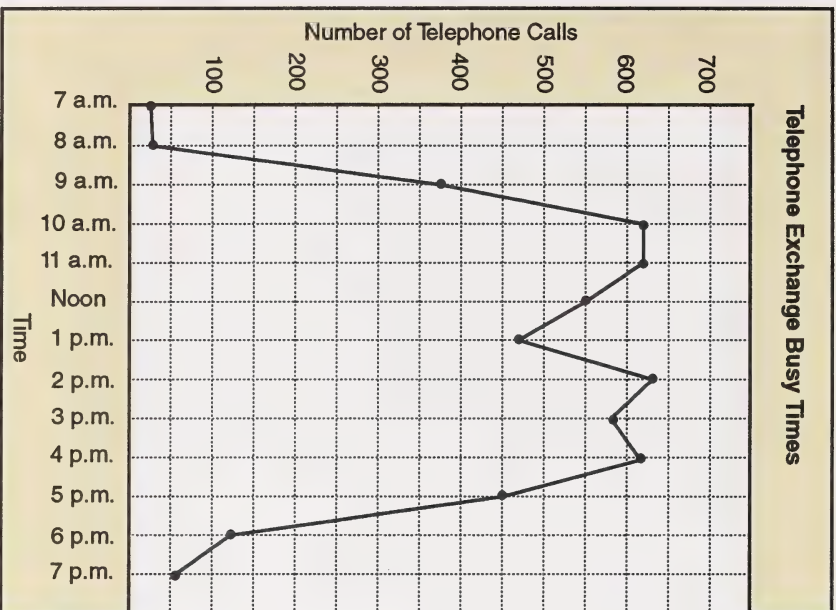
d. What was the highest speed attained by the aircraft?



Space for Your Work

2. Use the graph below to answer the following questions.

Space for Your Work



a. Between what hours were there more than 500 calls going through the exchange?

b. Try to explain why most calls are made between 9 a.m. and 5 p.m.

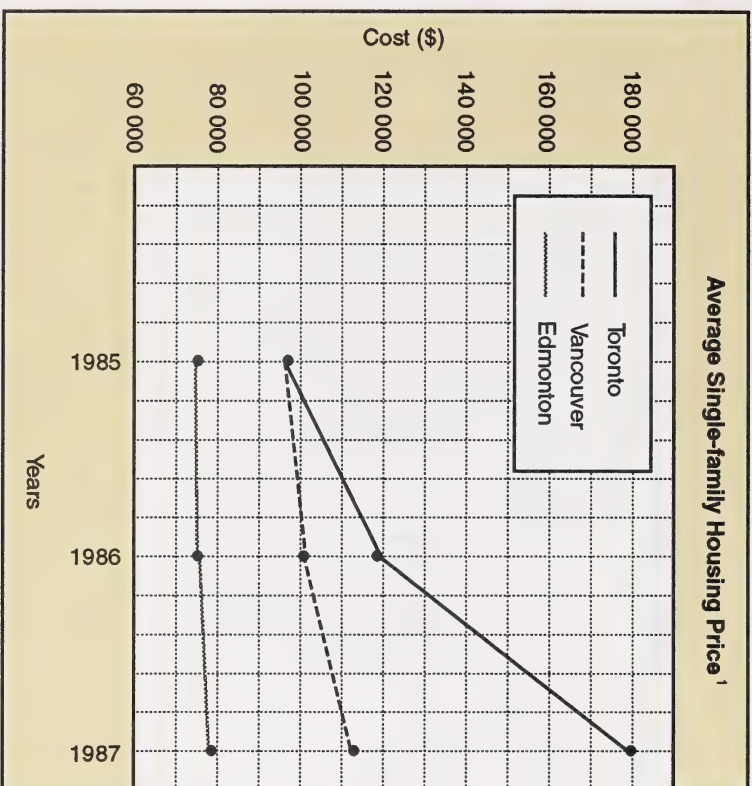
c. Why would there be a drop-off in calls between noon and 1:00 p.m.?

Space for Your Work



3. Use the graph to answer the questions on the next page.

Space for Your Work



¹ Statistics Canada.

- a. In which of these cities did the houses cost the most in 1987?
- b. In which of these cities did the houses cost the least in 1987?
- c. In which of these cities did the price of houses change the least from 1985 to 1987?

Space for Your Work



See your learning facilitator to check your answers and to receive further instructions.



Working Together

Constructing Line Graphs

Line graphs should have these features.

- a descriptive title
- horizontal and vertical axes which are named accurately
- good use of space (appropriate scales)
- points which are connected by smooth lines.

When constructing a line graph, you should spend some time deciding on an appropriate scale for the horizontal axis and an appropriate scale for the vertical axis. The scales for each axis can be different.

Consider the highest value and the lowest value for each axis. Choose a scale that will allow you to plot all points and make good use of the available space.

Example

Changes Heart Rate After Running (at Rest)

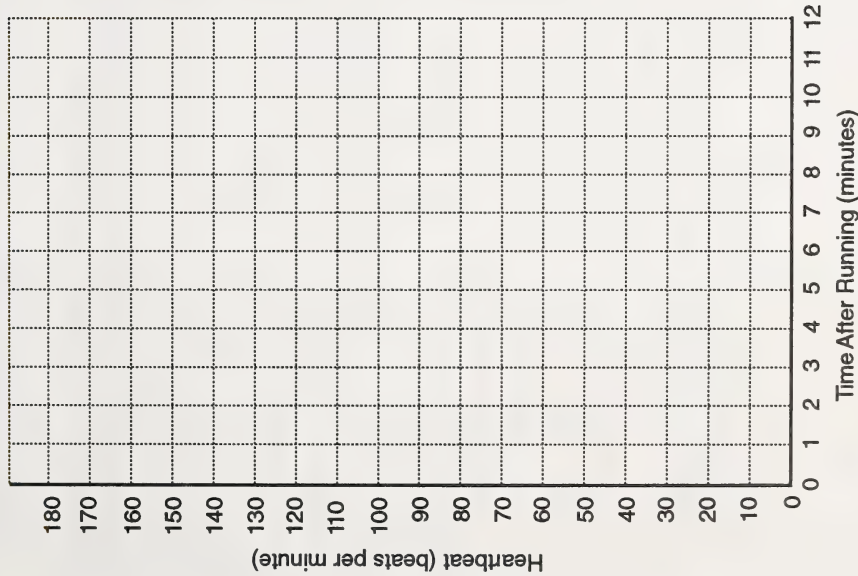
Time After Running (min)	Heart Rate (beats per minute)
0	180
1	165
2	150
3	135
4	120
5	110
6	100
7	95
8	90
9	85
10	80
11	80
12	80

Notice that times goes from 0 to 12 min. So, you can make each unit 1 minute. Notice that the heart rate goes from 80 to 180 beats per minute. So, you can make each unit 10 beats per minute.

Step 1

Label the title and axes (including the scale).

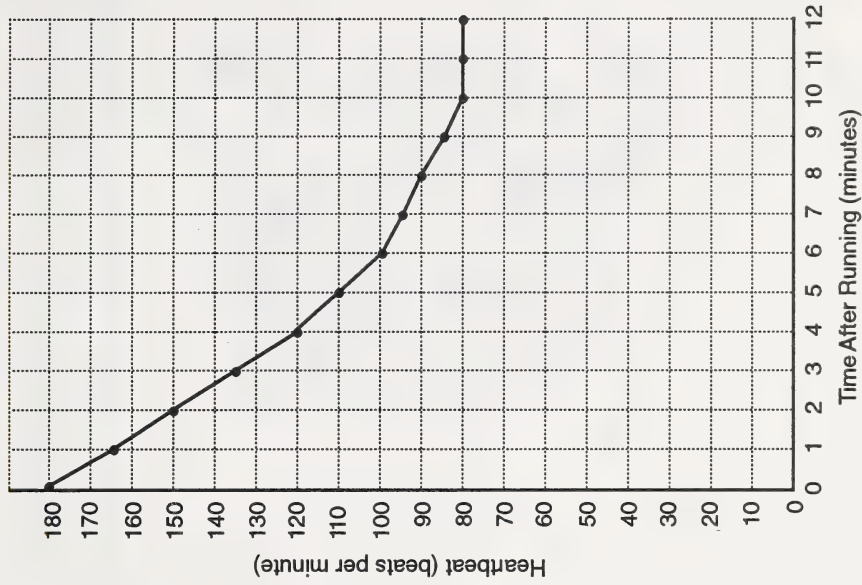
Change in Heart Rate After Running



Step 2

Plot the points and join the points.

Change in Heart Rate After Running

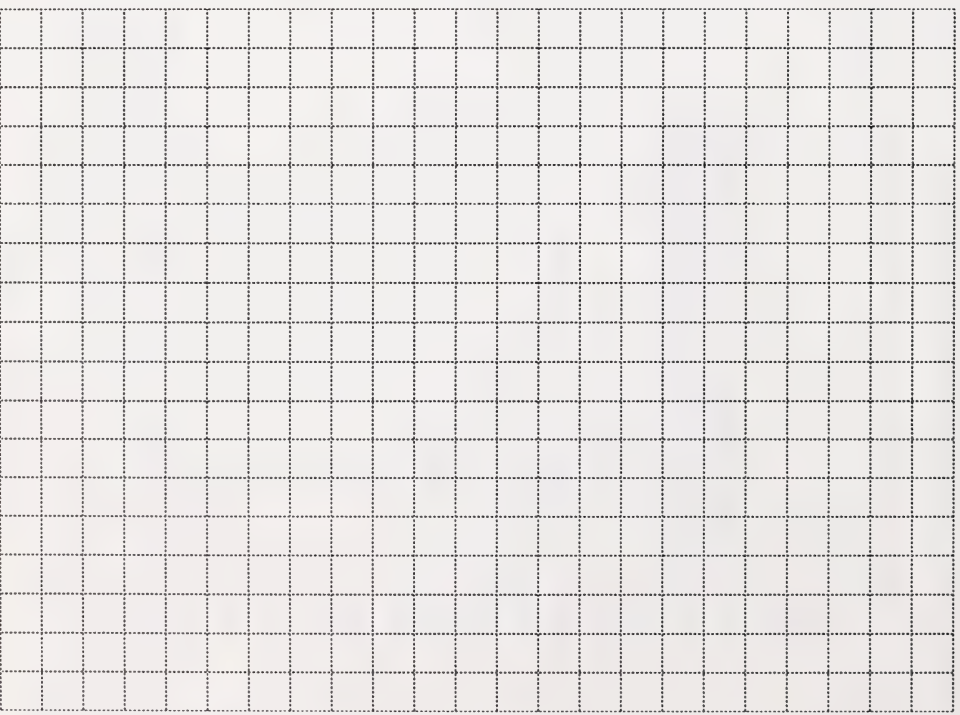
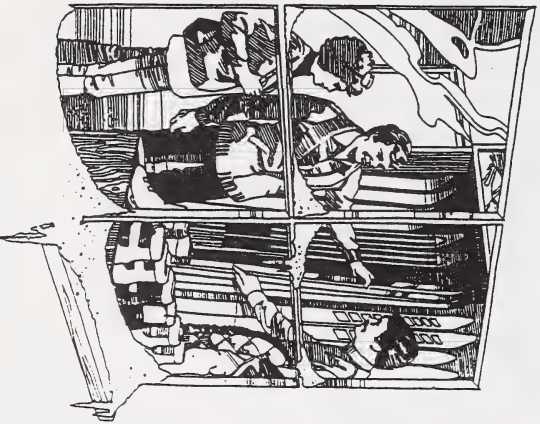


Practice Activities

Space for Your Work

- Below is data from McCarthy's Sporting Goods Store. Construct a line graph to display the data.

Months	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Sales of Skis	39	23	10	5	4	2	4	4	10	48	50	77

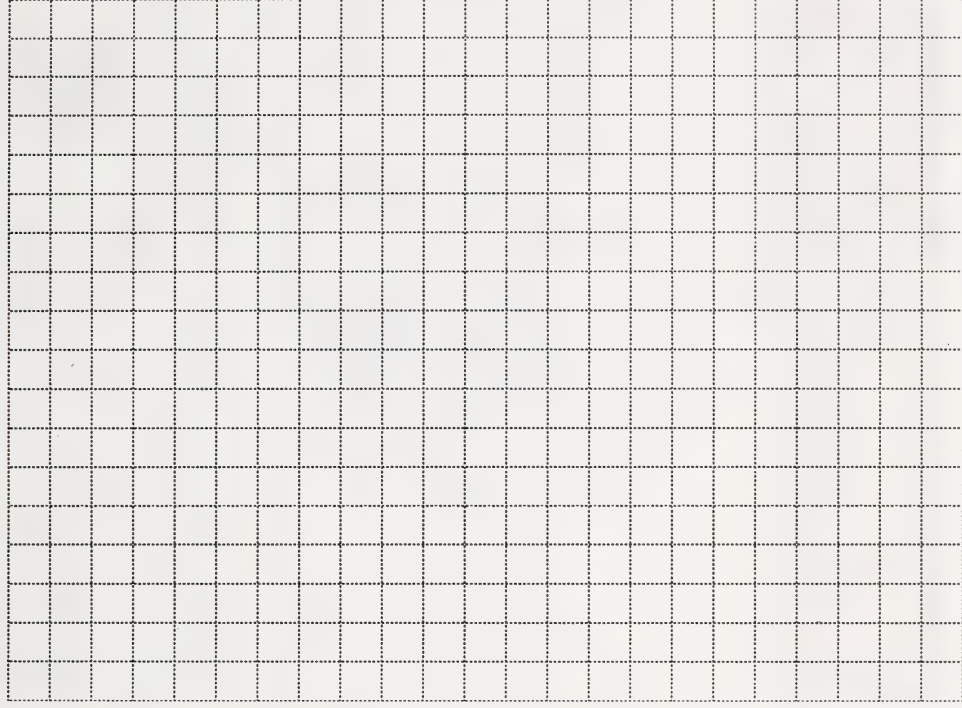


2. For a science fair Susan decided to see which kind of logs burned the hottest and longest. She burned three logs of the same weight. One log was poplar, one was tamarack, and one was birch. She placed a thermometer in front of the fireplace and took readings every 5 minutes. Here are the results.

POPLAR		TAMARACK		BIRCH	
Time	Temp.	Time	Temp.	Time	Temp.
0	20	0	20	0	20
5	24	5	23	5	22
10	27	10	27	10	27
15	28	15	27	15	28
20	34	20	28	20	30
25	35	25	30	25	35
30	35	30	32	30	35
35	34	35	34	35	38
40	30	40	34	40	40
45	28	45	30	45	40
50	26	50	30	50	40
55	25	55	27	55	38

Display this information on a line graph. Use different colours to represent the three kinds of wood.

Space for Your Work



Computer Alternative

Space for Your Work



3. If you require further practice plotting a point, do Lessons 18 and 19 on the *Pre-Algebra disk of Computer Drill and Instruction: Mathematics, Level D* (SRA)



See your learning facilitator to check your answers and to receive further instructions.



What Lies Ahead

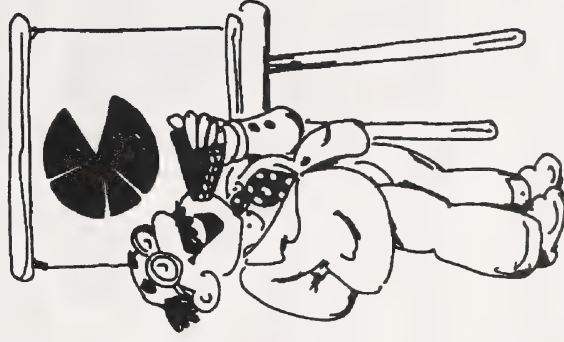
In this section you will learn these skills.

- interpreting circle graphs
- drawing circle graphs



Working Together

In this section you will learn about another form of data presentation, the **circle graph**. Because a circle graph is cut up into pieces, it is sometimes called a **pie graph**.



Interpreting Circle Graphs

Circle graphs are easy to understand.

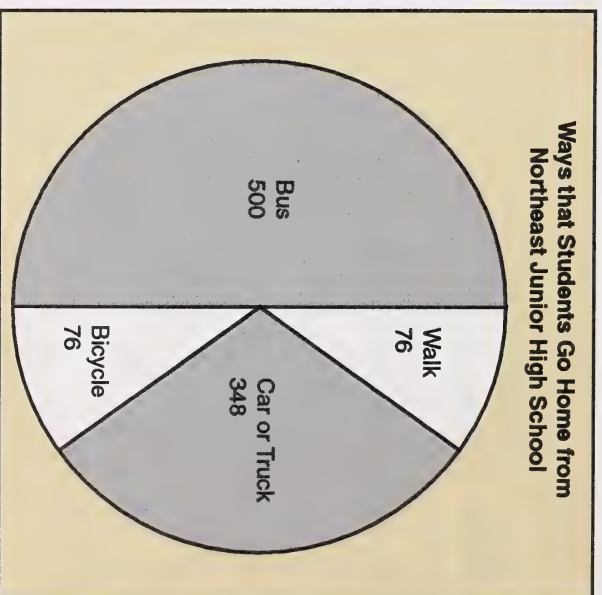
Example 1

Jane surveyed all the students at Northeast Junior High School to discover how they got to school.

**Ways that Students Go Home from
Northeast Junior High School**

Ways	Number
Walk	76
Car/truck	348
Bicycle	76
Bus	500
Total	1000

Jane then displayed this information in the circle graph at the right.



By merely glancing at the circle graph you should be able to see the following.

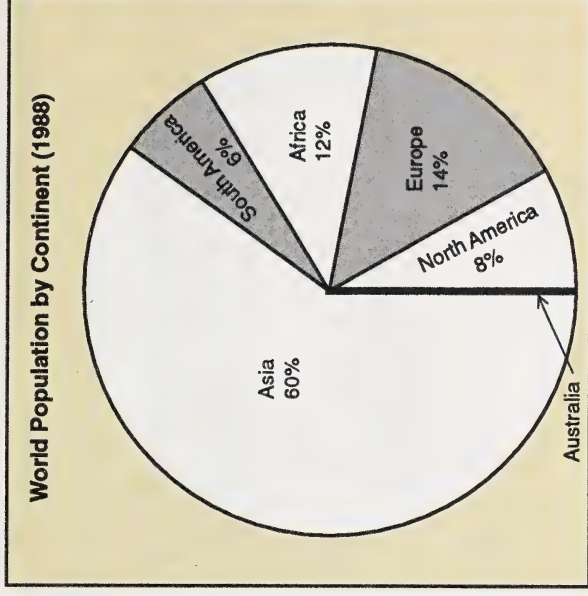
- Half of the students or 50% take the bus.
- About 35% of the students travel by car.
- About 15% of the students walk.
- About 15% of the students ride their bicycles.

Example 2

Krishnie discovers these facts about the world population.

- Asia has 60% of the world's population.
- Europe has 14% of the world's population.
- Africa has 12% of the world's population.
- North America has 8% of the world's population.
- South America has 6% of the world's population.
- Australia has less than 1% of the world's population.

She makes this circle graph to display the information.



You should be able to see these facts.

- Asia has more than half of the world's population (remember that China, India, and the USSR are part of Asia).
- Australia has the lowest population shown. It is simply represented by a line on the circle graph.
- Europe has about the same population as North America and South America combined.

If circle graphs have percents attached to each sector instead of numbers, you can use your knowledge of percents to calculate the numbers.

Example

Use the circle graph on the previous page to find the number of people in Asia in 1988 and the number of people in North America in 1988. There were about 5 billion (5 000 000 000) people in the world in 1988.

Solution

To do this, multiply the percentage given for the particular continent by the total world population.

$$\begin{aligned} & 60\% \times 5 \text{ billion} \\ &= 0.6 \times 5\,000\,000\,000 \\ &= 3\,000\,000\,000 \text{ people} \\ &= 3 \text{ billion people} \end{aligned}$$

So, there were about 3 billion people in Asia in 1988.

$$\begin{aligned} & 8\% \times 5 \text{ billion} \\ &= 0.08 \times 5\,000\,000\,000 \\ &= 400\,000\,000 \\ &= 400 \text{ million} \end{aligned}$$

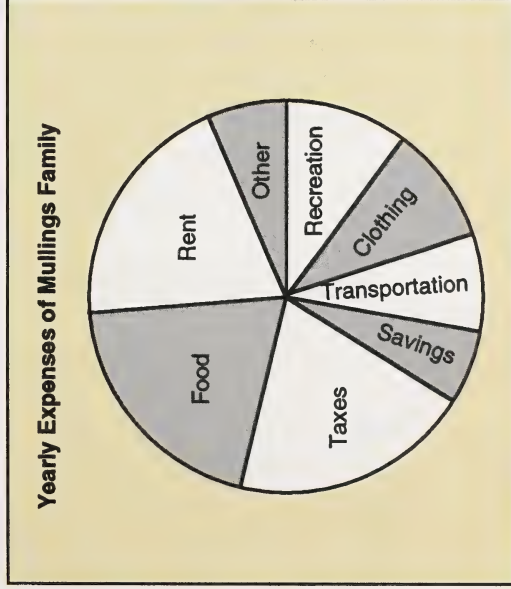
So, there were about 400 million people in North America in 1988.

Note

These are not exact answers, even though you calculated the percent of each number. Both the total population and the percents are approximate.

Some circle graphs do not have numbers or percents attached to the sectors.

Example



At a glance you can see that the three biggest expenses are rent, food and taxes. You can also see what the other expenses are.

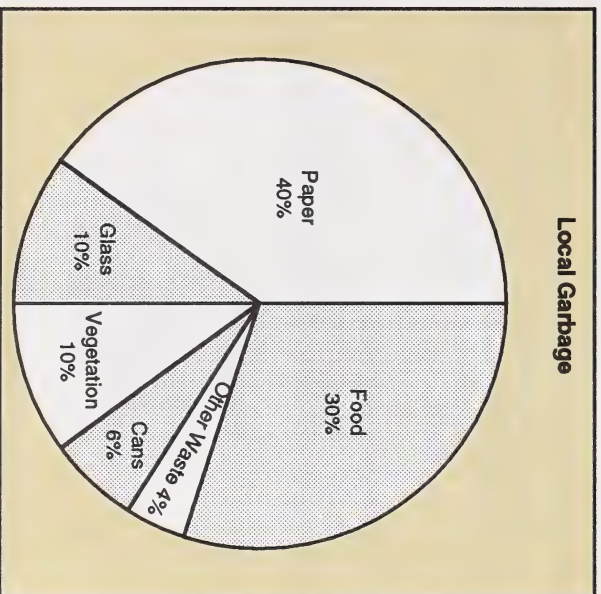
You could estimate the percents.

- Rent — about 20%
- Taxes — about 20%
- Food — about 20%
- Recreation — about 10%
- Clothing — about 10%
- Transportation — about 8%
- Savings — about 6%
- Others — about 6%

Introductory Activities

Space for Your Work

1. Look at the circle graph and then answer the following questions.



- a. Of which kind of garbage is there the most?
- b. How many times as much paper is thrown out as vegetation?

Space for Your Work

- c. In 1t (1000 kg) of garbage, how many kilograms are there of each of the following types of garbage?

(i) glass

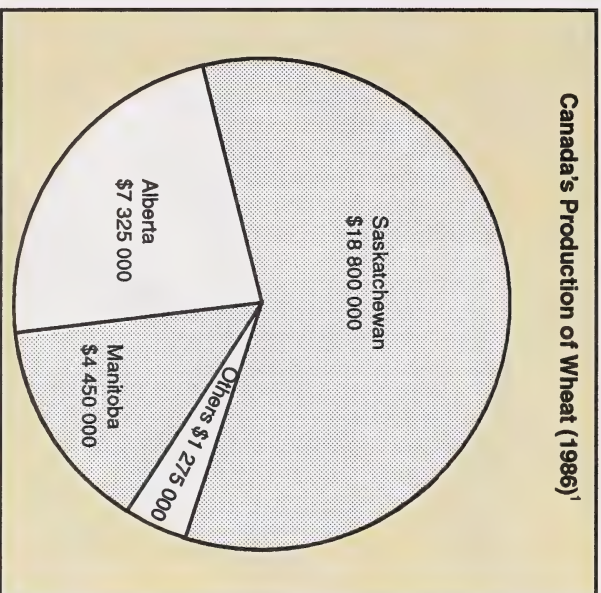
(ii) cans

(iii) paper

- d. If people could reuse the paper, the glass, and the cans, how much out of every 1000 kg would have to be thrown away?

2. Use the graph to answer the questions on the next page.

Space for Your Work



¹ Statistics Canada.

- a. Which province produced the most wheat in 1986?
- b. About what percent of the total production of wheat was produced in each province in 1986?
- (i) Saskatchewan

(ii) Alberta

(iii) Manitoba

Space for Your Work

Computer Alternative

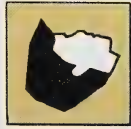
Space for Your Work



3. For more practice estimating percents on a circle graph, do "Pie Graphics" on *Disk C of MAC 7* (Houghton Mifflin).



See your learning facilitator to check your answers and to receive further instructions.



Working Together

How to Construct Circle Graphs

Example

Beatrice spends her day doing these activities.

working — 8 hours
sleeping — 8 hours
eating — 3 hours
recreation — 5 hours

Construct a circle graph to display this data

Solution

Step 1 Calculate the fraction of the day spent doing each activity.

working	$\frac{8}{24} = \frac{1}{3}$ or 33%
sleeping	$\frac{8}{24} = \frac{1}{3}$ or 33%
eating	$\frac{3}{24} = \frac{1}{8}$ or 13%
recreation	$\frac{5}{24}$ or 21%

Step 2 Next calculate the angles and round to nearest degree.

working 33% of 360°
 $= 0.33 \times 360^\circ$
 $= 119^\circ$

sleeping 33% of 360°
 $= 0.33 \times 360^\circ$
 $= 119^\circ$

eating 13% of 360°
 $= 0.13 \times 360^\circ$
 $= 47^\circ$

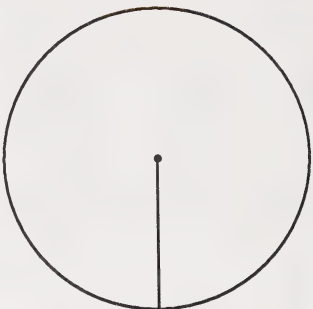
recreation 21% of 360°
 $= 0.21 \times 360^\circ$
 $= 76^\circ$

Note

Because of rounding, the angles total 361° instead of 360° .

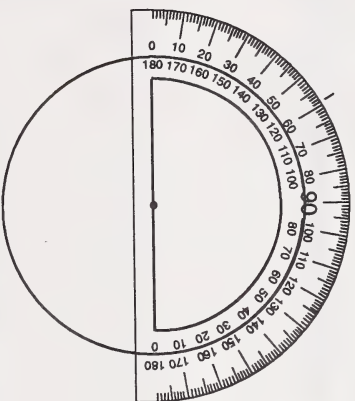
Step 3

Next draw a circle and an initial radius.



Step 4

Use this radius as a baseline and with a protractor measure an angle of 119° for the time spent working and mark off the angle.



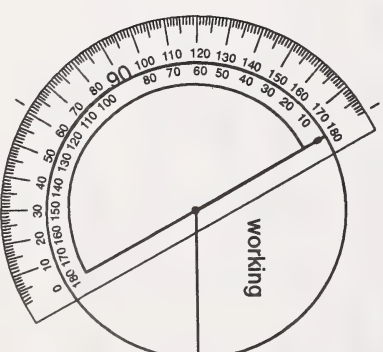
Step 5

Remove the protractor and join the measurement mark and label the sector.



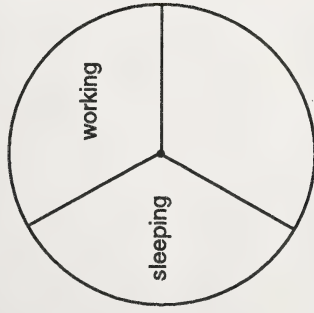
Step 6

Use this new line as a baseline to measure an angle of 119° for time spent sleeping and mark off the angle.



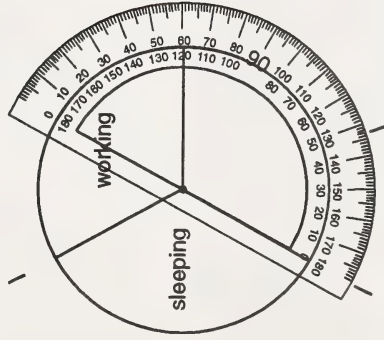
Step 7

Remove the protractor and join the measurement mark. Label the sector.



Step 8

Use this new line as a base line to measure an angle of 47° for the time spent eating.



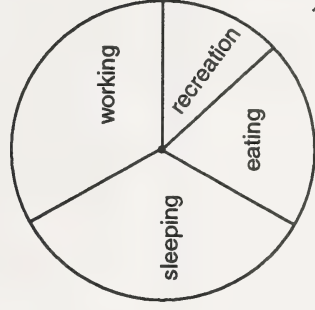
Step 9

Remove the protractor and join the measurement mark. Label the sector.



Step 10

The remaining sector is the time spent on recreation. Label the sector.



Practice Activities

Space for Your Work

1. George Grant's net income each month is \$2000. Here's how he budgets the money.

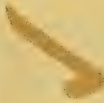
Expenses	Cost
Mortgage and property taxes	\$780
Food	\$540
Clothing	\$180
Medical	\$160
Transportation	\$100
Personal care	\$60
Gifts and entertainment	\$120
Household maintenance	\$60

Draw a circle graph to illustrate this data.

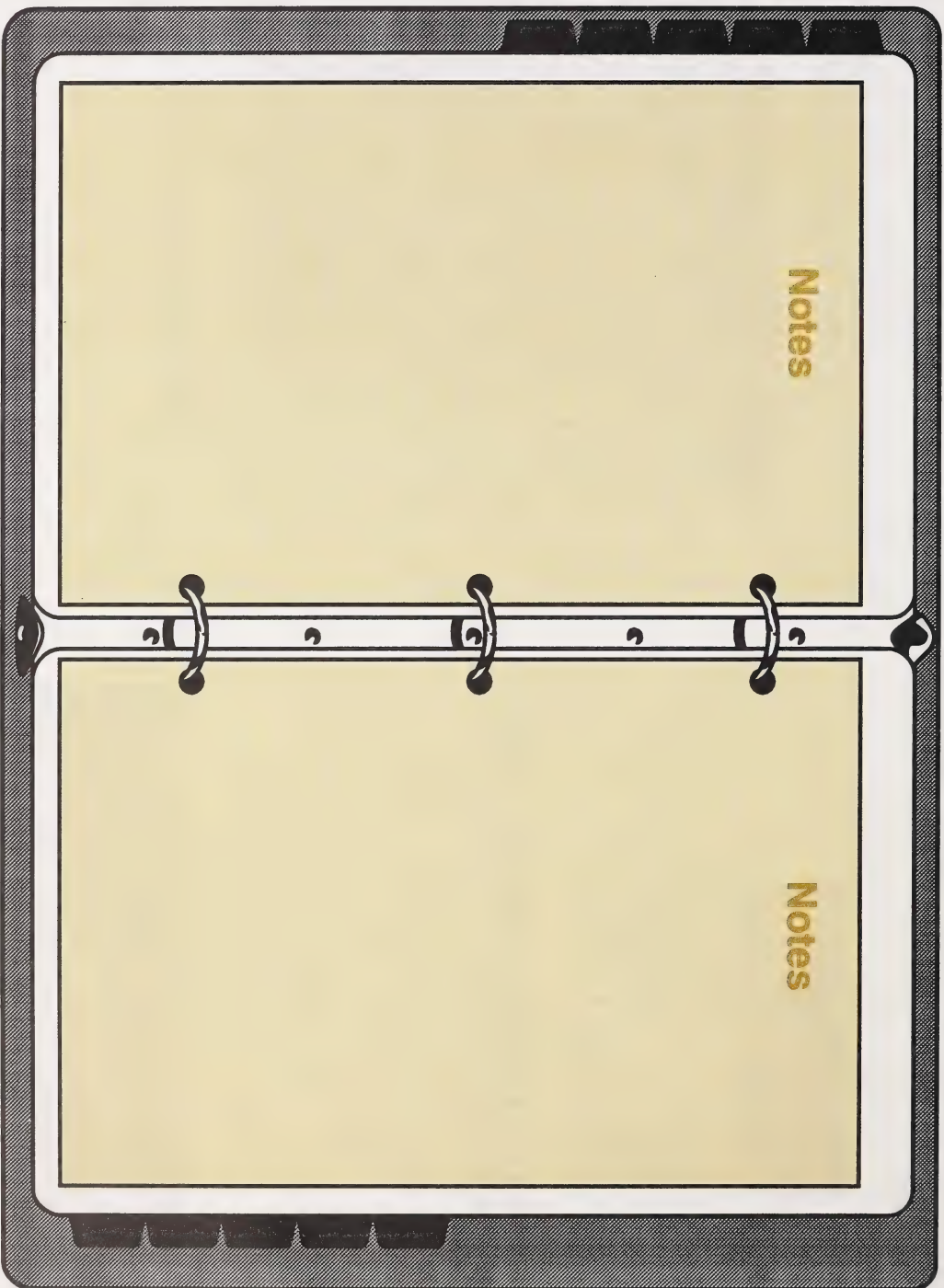
2. A package of cereal contains the following nutritional information.

Per Serving	
Nutrients	Mass
Protein	4.6 g
Fat	1.7 g
Sugar	13.5 g
Dietary Fibre	8.2 g

A serving is 28 g. Construct a circle graph to show the amount of each nutrient in a serving of the cereal.



See your learning facilitator to check your answers and to receive further instructions.





What Lies Ahead

In this section you will learn to recognize graphs that are used to misrepresent data.



Working Together

Advertisements try to present data about the sponsor's products in a favourable way. Sometimes advertisers stretch the truth by creating a false impression of the data. Don't believe everything that you read or see — or what you *think* you read or see.

Example 1



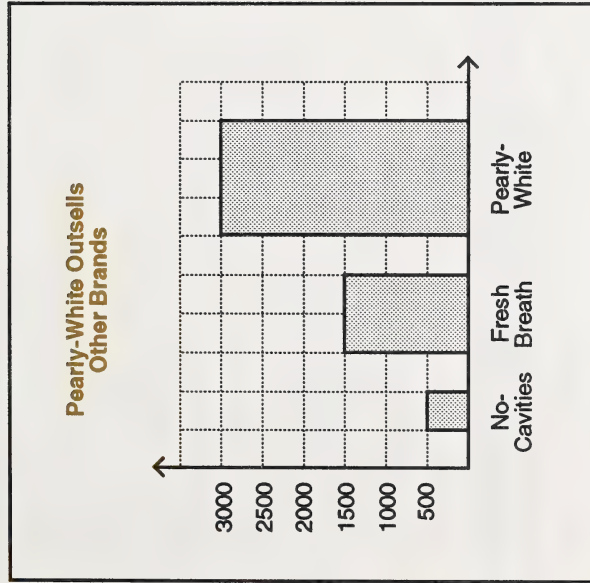
This pictograph is misleading because the area of the pictures is out of proportion to the sales. The sales in July are twice those in January. However, the picture representing the July sales is twice as tall and twice as wide as the picture representing January sales. So, the area of the second picture is four times the first. This gives the impression the sales in July are much greater than they are.

A more realistic graph would use individual pictures which are the same size.

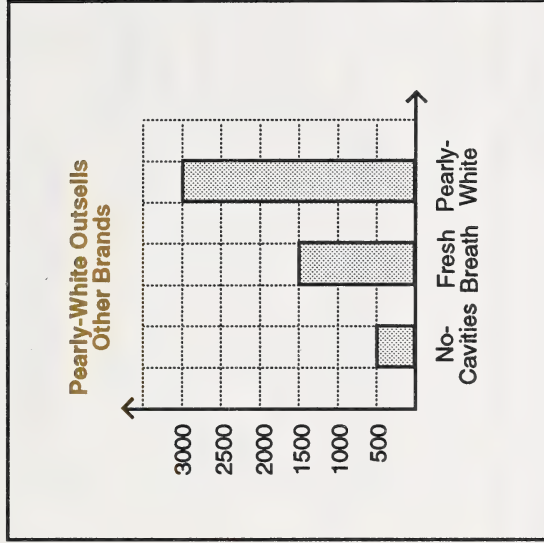


It is clear that twice as many sales were made in July.

Example 2



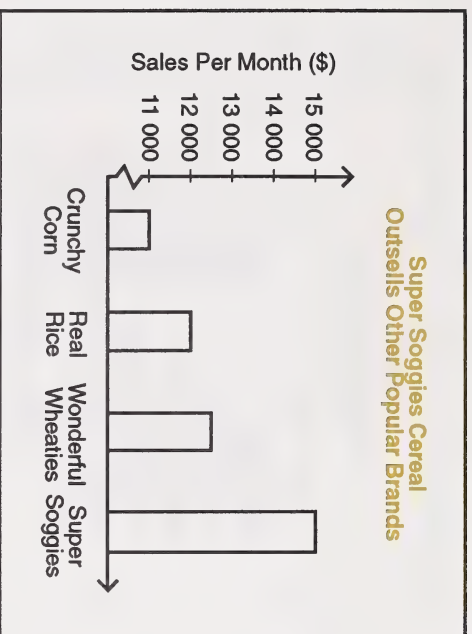
When bar graphs are drawn, the bars should be the same width. This graph is more accurate.



This example is similar to Example 1. Here the sales of Pearly-White are exaggerated by drawing the bars different widths. The sales of Pearly-White are six times that of No-Cavities, but the area of the bar is 18 times as great.

The sales of Pearly-White are twice that of Fresh Breath, but the area of the bars is three times as great.

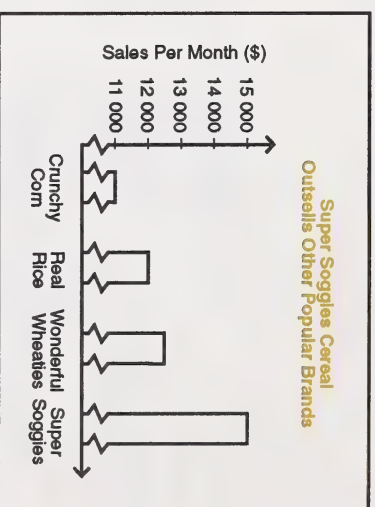
Example 3



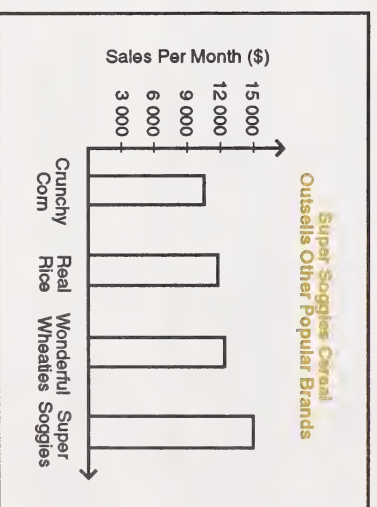
From the graph it looks as if Super Soggies' sales are double its nearest competition; the bar for Super Soggies is twice the height of the bar for Wonderful Wheaties.

The impression was created by breaking the scale on the vertical axis. The ↴ shows the scale is broken.

If the scale must be broken because of space constraints, it should be indicated both in the axis and in each bar.

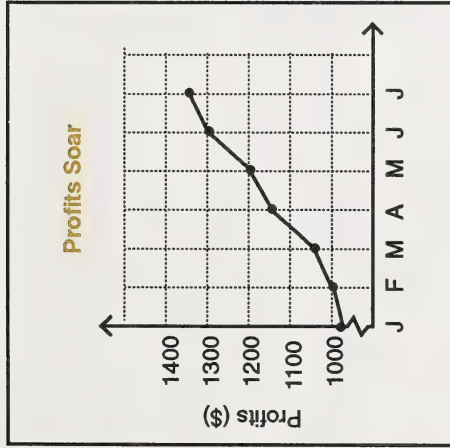


This graph, however, is more honest. The scale is not broken and bars are shown proportionally.

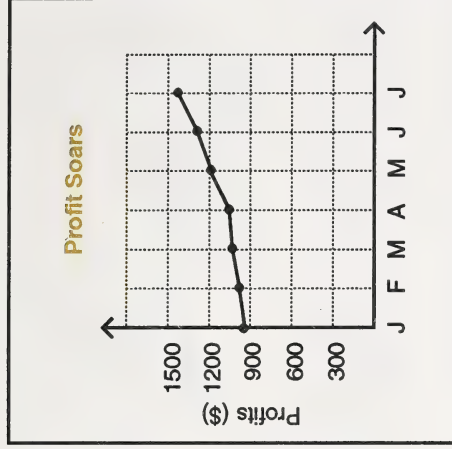


Example 4

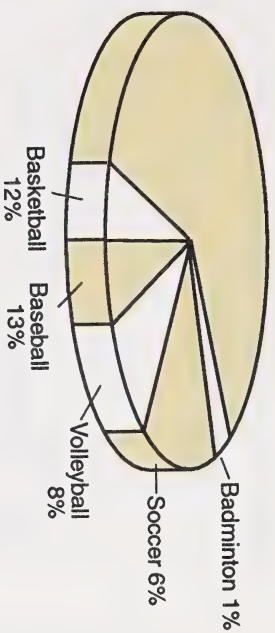
If the scale was not broken, the graph would look like this.



As in Example 2, the vertical scale is broken to give the impression that the profits are rising quickly.



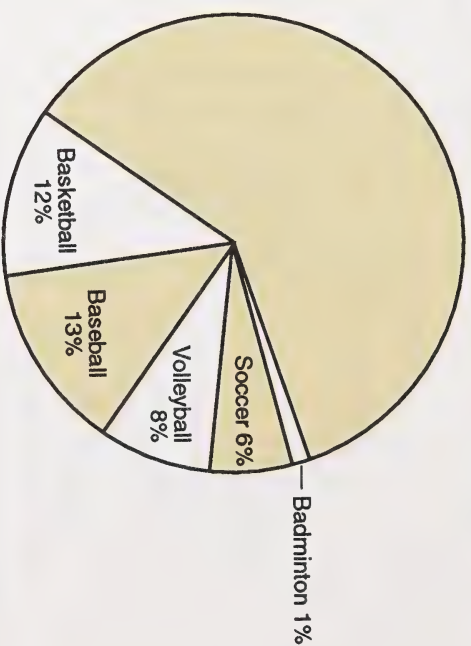
Example 5



It appears from the size of the pie-shaped wedges in this graph that more of the budget is spent on soccer than on basketball or baseball. This is not the case.

In an effort to make the graph appear to be three-dimensional, the angles have been distorted.

This graph is more accurate.

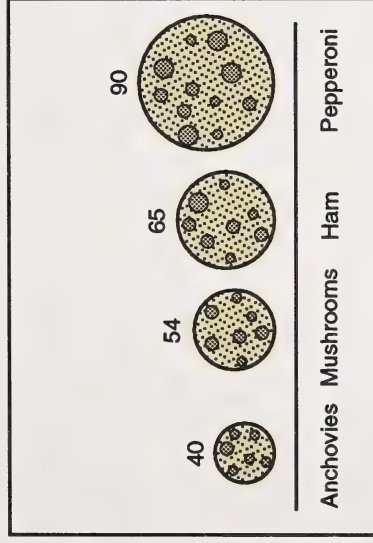


Practice Activities

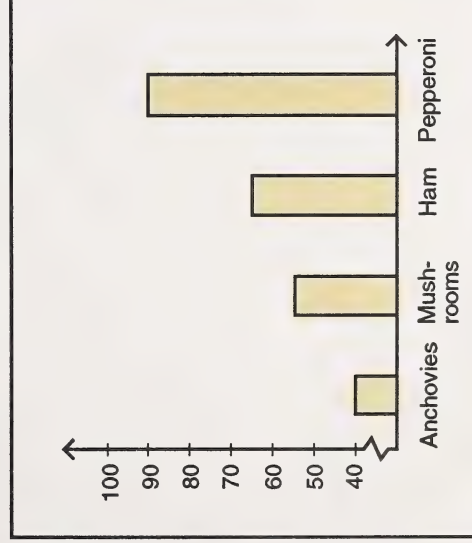
Space for Your Work

1. Explain why the following graphs are misleading. Then redraw the graphs more realistically.


a.



b.



2. Find examples of graphs that are misleading in newspapers and magazines. Explain why they are misleading.



See your learning facilitator to check your answers and to receive further instructions.



What Lies Ahead

In this section you will use these skills.

- interpreting a population and census methods
- interpreting a sample and sampling methods
- estimating properties of a population from sample results

In this section you will use these words.

- population
- property
- census
- sample
- sampling
- biased sample
- random sampling



Working Together

So far in this module you have learned about how data may be organized into graphs and how to interpret the data.

In this section you will think about the methods used to gather data.

Censuses

The total number or quantity of individuals or items from which information is collected is called a **population**.

Researchers count or measure some aspect or **property** of the population.

The method used to count or measure the property of an entire population is a **census**.

There are different ways to carry out a census to investigate a property of the population.

Example 1

Regan, the president of the student council at Northwood Junior High, must decide which colour to order for the school jackets – garnet, gold, or white. There are 320 students at Northwood High, and Regan wants to know their opinion before choosing the colour.

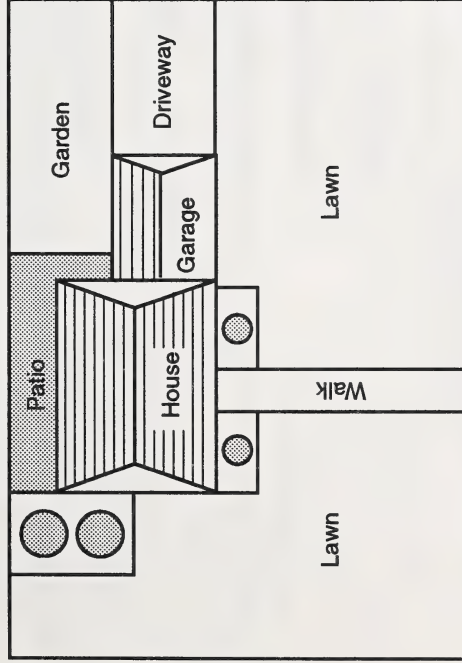


What property of the population does Regan want to research? The property of the students about which Regan wants data is their colour preference for school jackets.

How can Regan conduct a census to gather this data? She can obtain a list of the students names from the principal and interview each student or have them complete a questionnaire.

Example 2

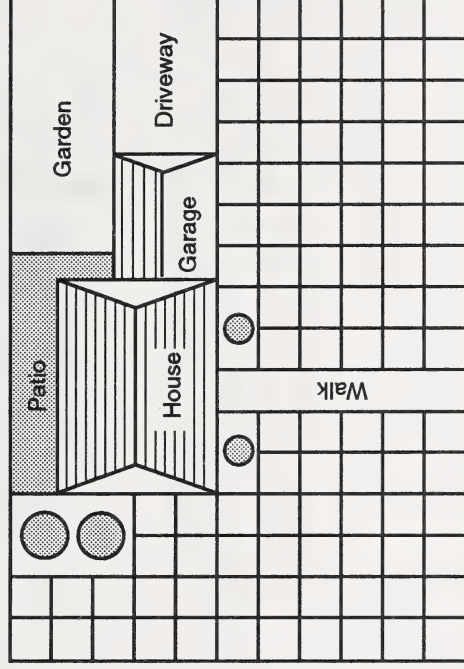
Stephen wonders if he should spray his lawn for weeds. To make his decision he wants to know what kinds of weeds are in his lawn and how many there are.



What property of the weeds in his lawn does Stephen want to research? He wants to know the kinds and numbers of weeds.

How can Stephen conduct a census to gather the data? He can identify and count each weed on the lawn.

However, it may be difficult to keep track of which weeds were counted. To ease the process Stephen could use string and posts to divide the lawn into 100 squares.



Then Stephen can identify and count the weeds in each square and then total these counts to make his decision.

Example 3



Martha is involved in an accident at an uncontrolled intersection. She believes the intersection is dangerous and their should be a traffic light there. To test her belief she wants to gather information about the number of traffic accidents at the intersection during the last ten years.

What property of the population does Martha want to research? She wants to know the number of traffic accidents at the intersection during the last ten years.

How can Martha conduct the research? The police in her town keep records of the traffic accidents that have happened there. Martha could research the records to see how many occurred at the specific intersection in the last ten years.

As you can see from these examples, data can be collected in several ways:

- using interviews
- using questions
- using observation
- using records

Introductory Activities

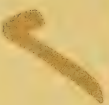
Space for Your Work

For each of the following, name the population and the property of the population that is being counted or measured. Then explain how a census could be conducted.

1. Mia wants to know how many of the children at the elementary school in her town come to school without eating breakfast.
2. Ralph wants to know how many earthworms there are in his garden.



3. Research the census of Canadians that is held every five years.
 - a. How is it conducted?
 - b. How much money does a census cost?
 - c. Why is the census necessary? What is done with the information obtained?
 - d. Is the census 100% accurate? Why or why not?



See your learning facilitator to check your answers and to receive further instructions.



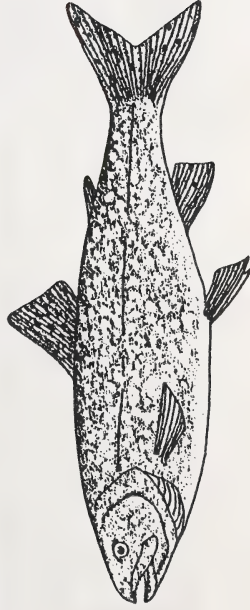
Working Together

Problems With Censuses

Sometimes it is very difficult or impractical to carry out a census.

Example 1

Clinton wants to know the length of the trout in Carson Lake?



What property of the population does Clinton want to research? He wants to know the length of the trout.

How can he conduct a census to gather the data? Clinton would have to try to net every trout in Carson Lake and measure them.

This would be very difficult for two reasons.

- The fish could not be kept out of water too long or they would die.
- If Clinton tags the dorsal fin of each trout and then releases them, it would be difficult to be certain every fish is captured and measured.

Example 2

Louise wants to know how far the roofs of the cars produced at her automobile factory collapse when they roll in an accident.

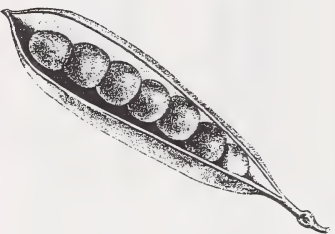
What property of the population does Louise want to research? She wants to know the distance the roof collapses when the car rolls.

How can she conduct a census to gather the data? She can do a test by rolling each car and measuring the roof collapse. However, this would damage or destroy all the cars so they could not be sold.

Sampling

In statistics, a **sample** is commonly used to estimate a property of the population, rather than conducting a census. A sample is a part of the population. You have been using a sample to make conclusions about populations for years, although you may not have realized it.

- When you opened a few pods of peas in your garden to see if the crop was ready to harvest, you were sampling.



- When you tested a spoonful of soup to determine if the soup had enough seasoning, you were sampling.

- When you watched a television program for a few minutes to decide if you should change the channel or continue viewing, you were sampling.

- When you were ill and your doctor took a vial of your blood, and tested it to see if your white blood count was elevated, this was a sample.

Video Activity

Watch the video **MATHWORKS: Sampling** or **SOLVE IT: Sampling** to learn about how a sample is chosen.

Choosing an Unbiased Sample

In order to make conclusions about a population from a sample, the sample must be representative of the whole population. That is, the sample should have the same properties as the population.

When taking a sample, you should be sure that the sample is selected without bias. Any special interest which causes a researcher to prefer one sample to another is **bias**. Bias prevents sampling from being trustworthy.

Bias can be eliminated from the sample procedure by selecting the members of the sample in a random way. For example, the members of a population are assigned a number, and the numbers are put in a hat. Then the hat is shaken and a number is drawn. This method gives every member in the population an equal chance of being chosen. The sample is called a **random sample**.

Choosing a Large Enough Sample

In order to make conclusions about a population based on a sample, the sample must also be large enough. There are no specific rules, but usually a sample has at least 30 members. For a small population, 10% of the population is sometimes chosen as a sample. For a very large population, 3% could be chosen.



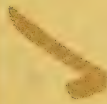
Practice Activities

Space for Your Work

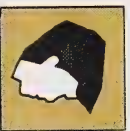
For each of the following, explain why the sample is biased.

1. Interviews were conducted with people randomly leaving or entering a swimming pool to determine how many people in the community can swim.
2. A questionnaire was handed out to students randomly selected from Hilcrest Junior High School to measure the popularity of a new video game among the teenagers in the community.
3. A telephone poll was conducted by telephoning people whose numbers were randomly chosen from the Calgary telephone book to determine the number of unemployed workers in Calgary.

4. A newspaper printed a survey form and counted the responses that were returned to determine their readership's attitude to capital punishment.
5. The population of bighorn sheep in Alberta was estimated by dividing the province into sections of 1 km^2 and then randomly selecting 500 of these sections to form a sample.
6. At a dinner party the hostess asked every second guest at the table their preference of after-dinner activities.



See your learning facilitator to check your answers and to receive further instructions.



Working Together

Now that you understand how to select a random sample, you are ready to use samples to estimate the population.

Example



Do you recall the problem in which Regan wants to discover the colour preferences of the 320 students at Northwood Junior High so she can order school jackets?

If Regan interviewed a random sample of 32 students, and discovered that 18 prefer garnet, 10 prefer white, and 4 prefer gold, estimate the number in the population who will prefer garnet.

Solution

Because the sample is representative of the population, the preference will be proportional. In other words, the ratio of students who prefer garnet to the total number of students will be about the same.



Sample Population

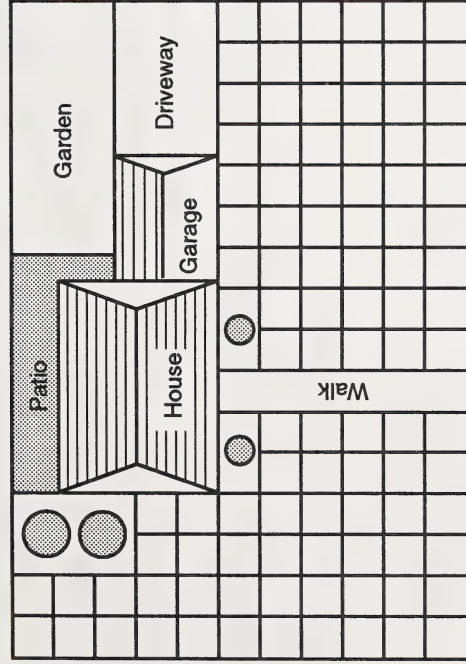
$$\frac{18}{32} = \frac{n}{320}$$
$$n = 180$$

So, about 180 students will prefer garnet.

$$\frac{18}{32} = \frac{180}{320} = 56\%$$

About 56% of the students will prefer garnet.

Example 2



Recall the problem in which Stephen wanted to find the kinds and numbers of weeds in the population.

If Stephen identified and counted the weeds in 30 randomly-selected squares on his lawn, and discovered that there were only 12 dandelions and 6 broad-leaf plantain in the sample, estimate the number of each type of weed in the total population.

Solution

The sample is representative of the population, so the kinds and numbers of weeds will be proportional.

Sample Population

$$\frac{12}{30} \doteq \frac{n}{100}$$

$$n \doteq 40$$



There are about 40 dandelions in his lawn.

Sample Population

$$\frac{6}{30} \doteq \frac{n}{100}$$

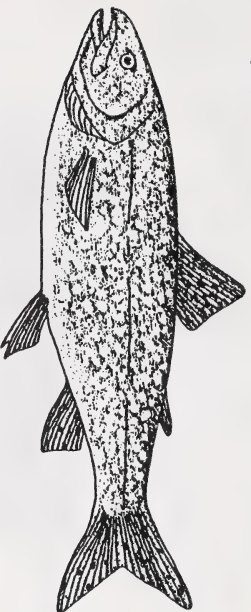
$$n \doteq 20$$



There are about 20 broad-leaf plantain in his lawn.

Example 3

The Fish and Wildlife Department uses the **capture-recapture** method to estimate the size of some wildlife populations.



In order to estimate the trout population in a lake in a provincial park, the wildlife officers randomly catch a sample of 200 trout with a net.

The wildlife officers put a plastic tag around the dorsal fin of each fish in the sample and then release the trout in the lake.

One week later the wildlife officers return and randomly net a second sample of 250 trout in the same lake. They find that 40 of these were caught the week before and release all the fish once more.

The wildlife officer uses a proportion to estimate the total number of trout in the lake.

In the catch In the lake

number of tagged trout
total number of trout

$$\frac{40}{250} = \frac{200}{n}$$

$$40n = 50\,000$$

$$n = 1250$$

There are about 1250 trout in the lake.

Concluding Activity

Space for Your Work

1. Sarah Wury picked 15 potatoes from 3 hills chosen at random on her farm. How many potatoes will there be in 60 hills.



2. Jackson randomly asks 2 people in a community of 832 if they can swim. He reports that 50% of the community can swim. Is this accurate? Why or why not?



3. Randy checks a random sample of 25 tires in every batch of 1000. If 2 tires in the sample are defective, how many in the batch are likely to be defective?



See your learning facilitator to check your answers and to receive further instructions.



What Lies Ahead

In this section you will review these concepts.

- keeping tallies and making frequency tables
- constructing and interpreting pictographs, bar graphs, line graphs, and circle graphs
- recognizing misleading graphs
- distinguishing between a population and a sample
- recognizing a biased sample



Working Together

At this point, it may be a good idea to review the skills you have learned in this module.

Turn to Section 1 and review the Pretest. Then correct any errors you may have made at the time. You may be pleasantly surprised to discover how much you have learned!



What Lies Ahead

The module assignment in this module conclusion will evaluate the achievement of objectives for this module.



Working Together

Now that you have studied Module 7 and you have done the required practice, you should be ready for the module assignment.

Module Assignment

Turn to the Assignment Booklet and complete the module assignment independently. You may refer to your notes, but do not get help from anyone. Afterwards, submit the assignment for a grade and feedback from your teacher.

APPENDIX

Bar graph: a diagram consisting of bars that represent data

Biased Sample: a sample that is not representative of a whole population

Census: a count or measure of a property of a population

Circle graph: a diagram in which a circle represents a whole and portions of the circle represent parts

Line graph: a diagram in which a line containing points represents data

Pictograph: a diagram that uses pictures to display data

Pie graph: a diagram in which parts of a whole are used to represent percents

Population: an entire set or group from which data is collected

Random sampling: the selection of a sample so that each member of the population has an equal chance of being chosen

Sample: a part of the population



MATH 8

9MA08P17

L.R.D.C.
Producer

FIRST EDITION
1992